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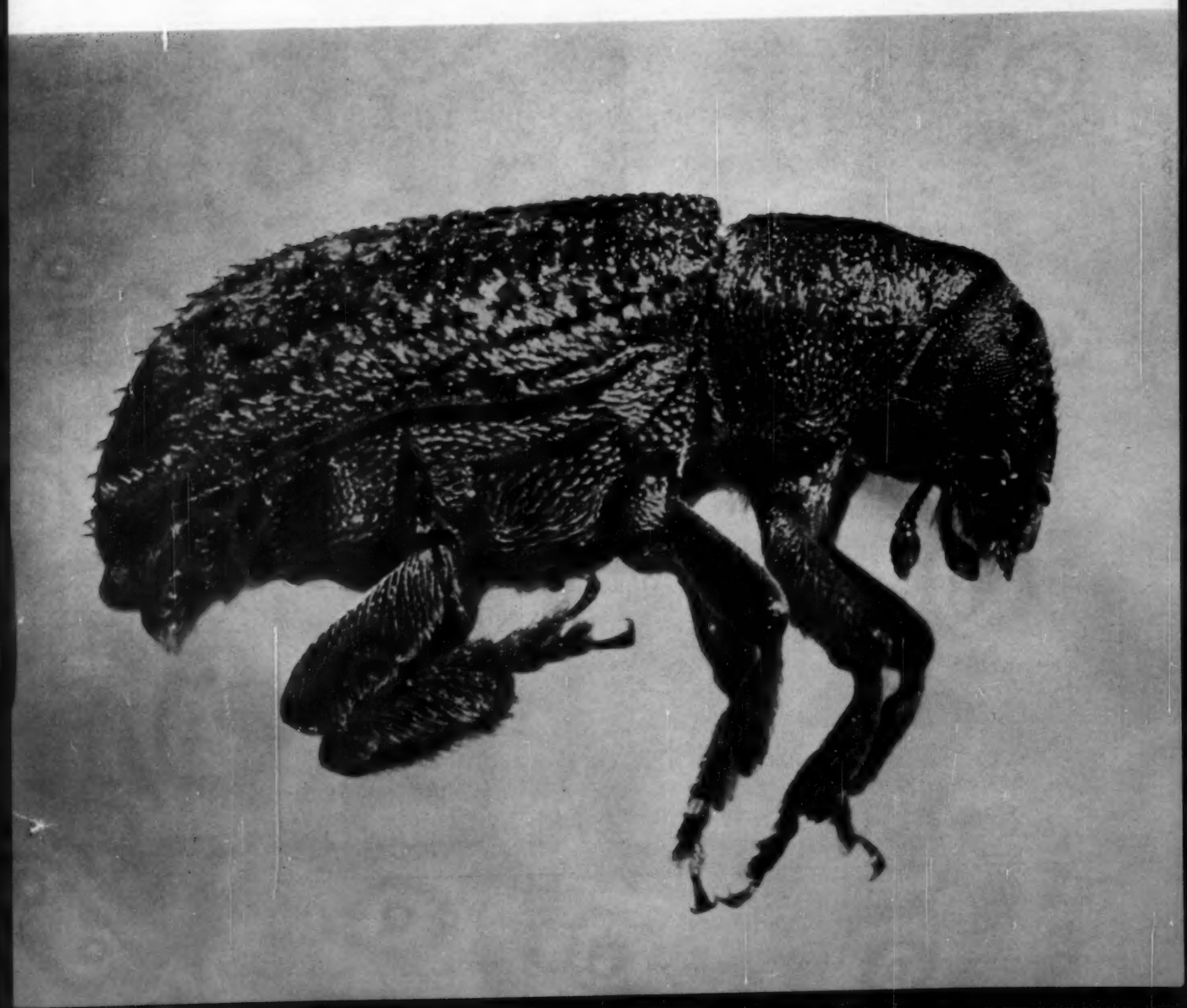

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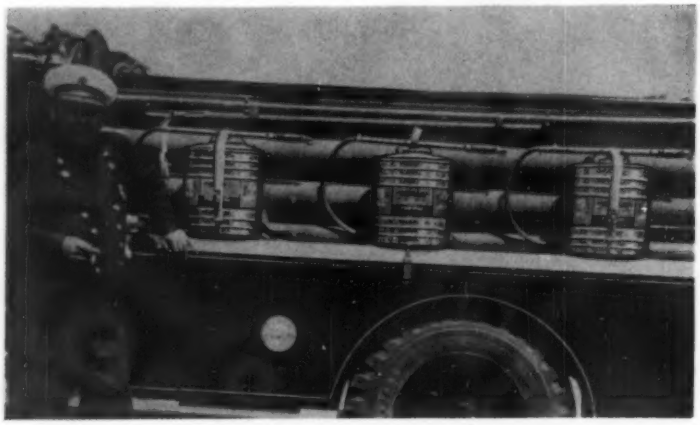

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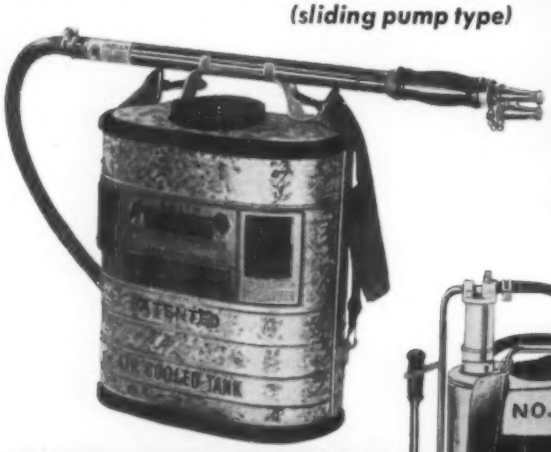

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Photo by U. S. Forest Service

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Seed Orchard Classification

Friedrich Ulrich Klaehn

A BETTER UNDERSTANDING of seed orchards is necessary if forest tree improvement work in the United States is to make satisfactory proggress. Zobel et al. (*49*) recognizing this need, recently prepared a paper covering in a rather detailed manner the procedures to follow in developing seed orchards. Despite the comprehensiveness of their report further discussion of seed orchards seems desirable to prevent costly mistakes in establishment and use. This paper reviews and evaluates pertinent foreign and American practices of seed orchard establishment, and shows that seed orchards can and will differ considerably depending on species under consideration as well as the purpose of the seed orchard. This leads us to the problem of classifying seed orchards.

Seed Orchard: A Definition

Larsen (*27*) uses the term seed orchard (syn. seed-garden, seed-plantation, or seed-source-garden) only for establishments concerned with genetically improved seed production. He thinks of seed orchards as composed of vegetatively reproduced plants originated from selected ortets[1] or of seedlings which have been raised after controlled pollination, usually after careful selection.

In Swedish and German papers dealing with seed orchards (*1, 2, 11, 12, 13, 16, 17, 18, 19, 20, 21, 22, 23, 25, 26, 28, 33, 35, 37, 38, 42*) the term is usually limited to plantations established with vegetatively reproduced plants, mostly grafts from carefully selected ortets. Zobel et al. (*49*) give the following definition of a seed orchard:

"A seed orchard is a plantation of genetically superior trees, isolated to reduce pollination from genetically inferior outside sources and intensively managed to produce frequent, abundant, easily harvested seed crops. It is established by setting out clones (as grafts or cuttings) or seedling progeny of trees selected for desired characteristics. Forest seed orchards are often established while genetic evaluation of parent material is still under way. In such cases, components shown by progeny tests to be genetically undesirable will subsequently be removed from the orchards."

The author feels that these definitions are too restrictive. Seed of a given genotype may be superior only with regard to one specific objective. In the case of special uses such as for Christmas trees, etc., the desired genotype is found in seed which would not be commonly called "superior seed." There are other cases where a representative average seed or seed of a specific strain is required. The kinds of seed described above, if obtained from a seed orchard, would not be included in the definition cited. A more useful definition might be as follows:

"A seed orchard is a type of plantation established with vegetatively produced stock or stock sexually produced and set up in a certain manner to provide easily harvested seed of specific quality, suitable for specific purposes, in the amount required."

Existing growing stands of certain quality should be called "seed stands," as this is common practice.

It is not the place here to discuss general or specific requirements which should be met by an ortet to qualify as a "superior tree," or ortets which may be used to produce seed for a specific purpose. Numerous publications are available that describe the procedure to follow (*6, 7, 15, 34, 40*). However, emphasis should be given

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[1]Ortet: The original plant from which a clone derives.

to the fact that a seed orchard, besides having many well known advantages concerning seed quality and seed harvest (*9, 20, 36*), also provides an excellent opportunity for combining trees which differ considerably in their economically important characteristics. For example, by placing clones of superior growth rate together with clones of superior wood quality, there is a good possibility that some offspring may have both characteristics.

Seed Orchard Classification

Seed orchards can and will differ considerably in their type, structure, number of clones involved, and other characteristics. Depending on the specific use for which they are established or depending on the desired type of seed, differences in the basic design are a necessity. For example, certain of the tree species under consideration are insect-pollinated and this requires changes from the current practices.

The basic types of seed orchards so far determined, both in German literature (*1, 37*) and other references (*7, 9*), and the purpose they serve are:

1. Regular seed orchards for the production of orchard seed, presumably somewhat genetically improved.
2. Elite seed orchards for the production of elite orchard seed (so proved by progeny tests).
3. Conservative seed orchards for keeping a certain valuable strain or strains, ecotypes, etc. available for the future.
4. Hybrid seed orchards for the production of interspecific hybrid orchard seed.[2]

Each of these four basic types may be further subdivided into: (a) *Wind-pollinated* (as with conifers and many commercially important species of hardwoods); (b) *Insect-pollinated* (as with *Prunus serotina, Liriodendron tulipifera, Acer* spp.); and (c) *Hand-pollinated*, as in certain cases of prolific hardwoods such as birches and alders, and certain conifers as described, for example, by Hyun (*14*).[3]

[2]Interspecific = between different tree species.

Type Specifications

Concerning this twelve-category classification, it may be felt that it is too detailed, or that excessive emphasis is placed upon insect or hand-pollinated types. This may be true at the present time. Types not very common in the United States such as "regular seed orchard, hand-pollinated type" or "hybrid seed orchard, wind-pollinated type" are available in Europe and other parts of the world. In addition, there is every reason to believe that there will be seed production in seed orchards established with insect-pollinated tree species. Preliminary work with tulip poplar and black cherry seed orchards has been initiated by the State University College of Forestry at Syracuse University.

a. Type 1 (a), *Regular seed orchard, wind-pollinated type.*—To the author's knowledge all seed orchards established to date in the United States fall into this category. In such orchards a minimum of 15 to 20 clones must be included to insure good and healthy offspring, but as many as 30 or perhaps 40 clones may be used. The danger of producing a high amount of empty or inbred seed as a result of too few clones is not very critical, because most species both have a high degree of self-incompatibility and produce large amounts of pollen, and because of other reasons (*38*). There are a few publications describing the clonal distribution in this type of orchard (*23, 25, 26, 27, 28*). In particular Langner and Stern (*26*) provide recommendations which can be accepted until better or simpler ways are found. Whether to plant or set up the clones in square or triangular spacing is closely related to the distribution itself. Langner and Stern (*26*) and others recommend triangular spacing in this type of orchard. For additional information see Table 1.

b. Type 1 (b), *Regular seed orchard, insect-pollinated type.*—What has been said about Type 1 (a) is also true to a certain degree of Type 1 (b). It is thought however, that certain modifications may be necessary or worthwhile. Colonies of bees should be placed in an insect-pollinated orchard, as is done in horticulture, to insure good cross pollination. The number of clones necessary to achieve this may be less than would be needed in wind-pollinated types. The spacing and clonal distribution should be modified according to the location of the bee hives.

c. Type 1 (c), *Regular seed orchard, hand-pollinated type.*—In this type of seed orchard the best clonal distribution will consist of rows or groups so that one row or group of grafts consists of one clone and the next row or group of another clone. Also, care should be taken to cover the whole graft to keep out unwanted pollen. In practice this means that height growth of the grafts must be rather limited. All clones involved in this type must be tested in respect to self-compatibility before they are used. If they show self-compatibility it should be possible to eliminate the inbred offspring in the seed bed. If the inbred seedlings cannot be eliminated, the clones from which they originated should not be used except when it is economical to cut off all male flowers before cross pollination occurs.

d. Type 2 (a), 2 (b), and 2 (c), *Elite seed orchard of various types.*—To the author's knowledge no elite seed orchards exist at present. Such types, however, probably will be established or available in the southern United States and in Europe in approximately ten years. Though the three elite

[3]There is no doubt that any kind of seed orchard classification system must tie into seed certification. The State of Georgia, with this consideration in mind, has included seed orchards in the seed certification standards which have been developed (10). They do not however, distinguish between different seed orchard types. The manner in which seed orchard types, together with their seed, may be connected with any kind of seed certification program, depends largely upon general (field) standards, such as laws applied to certain species, etc. It seems worthwhile, however, not to overlook the importance of some of the problems discussed in this paper when working on similar problems.

types are generally similar to the regular types, elite types deal only with clones which provide genotypically superior offspring. In many cases it will be possible to transform a regular seed orchard into an elite seed orchard, as it is planned in the South, by eliminating all clones which fail to provide genetically superior offspring. In other cases such orchards may be established by using "secondary" scion material harvested from existing grafts. Eight to ten clones, or less, are sufficient for elite types since their general and specific combining ability resulting in genetically superior offspring is usually exactly known. Eight clones, for example, have 56 possible cross combinations, whereas ten clones give 90 possible combinations. On the other hand, the standards used, to determine what is or is not genotypically superior, will limit or enlarge the number of clones that may justifiably be included.

e. Type 3 (a), 3 (b), and 3 (c). *Conservative seed orchard of various types.*—The selection of ortets to be used in conservative seed orchards is a primary consideration. The ortets may be (1) rare specimens of a given species, (2) trees of quite different genetical makeup growing in areas where environmental factors result in poor seed production, for instance Douglas-fir from higher elevations, etc., (3) plants of more or less the same ecotype, selected from a very valuable natural stand which is going to be cut, or where certain hazards make it very unlikely that this stand will be available for seed production in the future.

A conservative seed orchard, derived from ortets of types (1) and (2), is similar in its establishment to the regular seed orchard type. When working with clones derived from genotypically more or less closely related genotypes however, as when working only with one specific ecotype, the number of clones included could be less. The offspring obtained from grafts of ortets of type (3) is probably no more than a representative average of a certain ecotype.

TABLE 1.—SOME IMPORTANT PROBLEMS OF CLASSIFICATION

Seed Orchard Type (Basic types)	Pollination done by; W (Wind) I (Insects) H (Hand)	Type No. in the publication	Age class limits of the ortets NM (Nearly mat.) M (Mature)	No. clones involved[1] Mi. (Min.) Ma. (Max.)	Clonal distribution:[2] Ra. (Random) St. (Certain statist. des.) Ch. (Checkerboard)	Clone set-up[3] Ro. (Rows) G. (Groups) Tr. (Triangle)	Isolation feet (Minimum)	Remarks
Regular seed orchard for somewhat "improved seed production"	W	1 (a)	M	Mi. 15-20 Ma. 30-40	Ra. or St.	Tr.	500-1000	Offspring testing strongly recommended
	I	1 (b)	M	Mi. 10 Ma. 20	G. (Groups consisting of one ramet[3] per clone)		300	
	H	1 (c)	M	Mi. 8	Ro. (Each row consisting of one clone) or G. (Each group consisting of one clone)		None	
Elite seed orchard for "elite seed production"	W	2 (a)	M	Mi. 8-10 Ma. 15	Ra. or St.	Tr.	500-1000	Offspring testing must be completed
	I	2 (b)	M	Mi. 5 Ma. 5	G. (Groups consisting of one ramet[3] per clone)		300	
	H	2 (c)	M	Mi. 5	Ro. (Each row consisting of one clone) or G. (Each group consisting of one clone)		None	
Conservative seed orchard for the production of "conservative orchard seed"	W	3 (a)	NM	Mi. 10 Ma. 15-20	Ra. or St.	Tr.	500-1000	Offspring testing can be done
	I	3 (b)	NM	Mi. 10 Ma. 15-20	G. (Groups consisting of one ramet[3] per clone)		300	
	H	3 (c)	NM	Mi. 5 Ma. 10	Ro. (Each row consisting of one clone) or G. (Each group consisting of one clone)		None	
Hybrid seed orchard for the production of "hybrid (inter-specific) seed"	W	4 (a)	NM	Mi. }2 Ma. }	Ch.	Tr.	500-1000	
	I	4 (b)	NM	Mi. }2 Ma. }	G. (Groups consisting of one ramet[3] per clone)		300	
	H	4 (c)	NM	Mi. 2 Ma. more	Ro. (Each row consisting of one clone) or G. (Each group consisting of one clone)		None	Offspring testing must be completed

[1]The number of clones involved in the different types of seed orchards is flexible in types 1(c), 2(c), 3(c), and 4(c), and depends solely on the isolation facilities, the labor and funds available, the very species we are working with and other factors.

[2]"Clonal distribution" and "Clone setup" are very similar in their meaning. We decided however, for greater clarity, to separate the terms. There are other solutions possible and perhaps to recommend besides those mentioned in the table. This is particularly true for types 1(b), 1(c), 2(b), 2(c), 3(b), 3(c), 4(b), and 4(c).

[3]Ramet: An individual member of a clone.

f. Type 4 (a), 4 (b) and 4 (c), *Hybrid seed orchard of various types.*—Significant differences exist between the three types discussed so far and any kind of hybrid seed orchard. A hybrid seed orchard should be made only under special circumstances and in the following way:

(a) Species involved must cross readily with each other in both directions. This requires that there is adequate overlapping in the time of flowering.

(b) The parental species must provide offspring with clearly expressed hybrid vigor (heterosis), or must be otherwise of particular value. This means the combination has to be tested before the orchard is set up.

(c) There should be only one clone of each species used. If two or more clones of each species were included, intra-[4] as well as interspecific offspring would result. The intra-specific offspring is unwanted.

(d) Checkerboard distribution is necessary and recommended for wind- and insect-pollinated types. In the hand-pollinated type however, establishments in rows or groups is preferable.

Special Problems Which Require Modification

The discussion so far has dealt only with species which are monoecious, i.e., where male and female sexes are located on the same tree but in different flowers, and trees with perfect flowers, i.e., where male and female sex organs are to be found in the same flower. There are however, certain tree species which are dioecious (poplars, willows, certain ashes and maples), or polygamous (ash and maple species).

Tree species which fall into the dioecious and polygamous groups require special attention. Seed orchards of American ash (*Fraxinus americana*) for instance—a species which is included in the seed orchard program at State University College of Forestry at Syracuse University—require that there are enough male clones for the number of female clones. One male clone can pollinate and fertilize two or perhaps three, female clones easily.

When working with polygamous tree species, care must be taken in selecting the clones wanted in the orchard. Since the amount of pollen produced by clones having exclusively perfect flowers is usually small, one or several exclusively male clones for a certain number of female or perfect clones should be used. In any case the flowering conditions as well as the flowering time must be studied in detail before a seed orchard with polygamous tree species can be developed (*24, 43*).

Another quite common type found in Europe, particularly in larch species, is a modification of Type 1 (a). It may be called the "vineyard type." The basic idea is the same as that of regular vineyards. The grafts are placed and tied to wire fences so that the quite open crown is exposed to the sun as much as possible. This means that the fences should be placed in an easterly to westerly direction. Southern aspects are very favorable locations. Orchards of this type are very productive in Europe. This type seems to be well suited for certain hardwoods and also softwoods.

Other Important Considerations

It is felt by the author that most people, who are going to initiate a seed orchard program, base the size of their orchard on the amount of seed they want to harvest in the future. There are several reasons which speak against this concept. First, it should be remembered that the selection of suitable trees is a continuous program and demands both experience and time. Large seed orchards established in perhaps three or four years indicate that not enough care has been taken in selecting the ortets. Secondly, it is obvious that a large seed orchard, Type 1 (a) for instance, with perhaps 25 clones and each represented 50 or more times, is very difficult to handle without a large amount of man power. Thirdly, offspring testing is more difficult than most people believe, although up-to-date tree breeders are experimenting and discussing how to do this in the best manner to overcome the difficulties. Twenty-five clones in one single orchard provide a total of 600 different cross combinations. Separate testing of each is impossible. The use of one or more local pollen providers or a pollen mixture of all or certain clones or other methods (*37*) facilitates testing considerably, but does not eliminate all problems. A much better idea is to start with a small seed orchard unit (small in area and with a limited clonal number), which can be enlarged as soon as it is known how the first establishment is coming along.

Seed orchards of different types, which the author has either visited or established, differ considerably in their spacing. The spacing range is from 12 to 40 feet. There is no doubt that each species under consideration demands a certain limited space. On the other hand spacing above 30 feet can result in a failure to utilize valuable pollen. This is particularly true in windy and open places. This negative effect will be increased when some grafts are killed, or removed because of lower value. A spacing range not less than 14 but not higher than 30 feet is recommended, depending on the arrangements in rows, groups, or triangles. Wind-pollinated orchards can be spaced a little wider than insect- and much wider than hand-pollinated orchards.

The choice of where to establish the orchard from the viewpoint of soil and climate has been discussed widely by Zobel et al. (*49*). The same can be said about treatment to stimulate flower and fruit production, and how to avoid difficulties. Special thoughts however, must be given to the use of the "improved," "elite," "hybrid," and other seed. Is it worthwhile and correct to establish stands exclusively with such seed or is it

[4] Intra-specific = within the species.

perhaps better and more economical, at least in the beginning, to use a local strain in mixture since the first and perhaps also the second thinning is less likely to provide merchantable material The trees removed on the average will be of lower value favoring the remaining trees which likely will be those originated from the seed orchard seed. Another reason which favors the use of orchard seedlings in mixture with a local strain, at least in many areas in the United States, is that the local strain will serve as trainers resulting in straight stemmed, high quality trees from the orchard seedlings. Eventually the faster growing orchard seedlings will overtop and eliminate the local strain. Thus thinning can be postponed until rather late in the development of the stand with a greater likelihood of merchantable material resulting.

In Table 1 some of the more important problems in relation to the classification system are presented. Included are age class limits of the ortets, number of clones involved in each of the twelve orchard types, clonal distribution and clonal setup, isolation minimum, etc. The figures given under number of clones involved are more flexible in certain types than in others. The same can be said about clonal distribution and clonal setup.

Conclusions

It is the belief of the author that the whole seed orchard problem is not so much one of concentrating on which trees are genotypically superior and, therefore, worthwhile to be included in a seed orchard program, but rather on the simple question of which type of seed is needed, where it is wanted, and what the requirements are for such seed. Following this is the problem of where to find the ortets which can be used most successfully.

In conclusion the whole seed orchard problem as illustrated by Zobel et al. (*49*) and this paper is very complex. Seed orchards available in the United States are still in their initial phase. The lack of detailed information about such problems as soil conditions, fertilization, and other treatments and problems concerning periodicity, duration of seed production, and others should not discourage the establishment of seed orchards. Those who consider all the factors involved in reaching the objectives of a seed orchard will increase their chances of success.

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Notice to Contributors

The backlog of accepted but unpublished articles and notes for the JOURNAL OF FORESTRY approximates the number contained in ten issues of the magazine. This is not an unusually large backlog for a scientific or professional publication. It is, however, larger than is desirable from the standpoint of contributors, readers, or editors. Steps are being taken to reduce the size of the backlog. These, combined with the usual seasonal reduction in unsolicited contributions during the summer and early autumn, should result in a more workable volume within the next several months. In the meantime, we will in scheduling articles and notes for publication give primary consideration to the period they have been awaiting publication.

Specific Gravity and Tracheid Length Variations in Second-Growth Western Hemlock[1]

R. W. Wellwood

WESTERN HEMLOCK (*Tsuga heterophylla* [Rafn.] Sarg.) is one of the four major timber-contributing species of the Pacific northwest. The most extensive forests are found in southeastern Alaska, coastal British Columbia, western Washington and western Oregon, but its range extends southward into coastal California and inland into southeastern British Columbia and the adjoining parts of Washington, Idaho, and Montana (*12*). This species is the principal timber of coastal Alaska (*23*). It ranks second to Douglas-fir in British Columbia's lumber production and second to the spruces in the forest inventory (*4*). It ranks second in standing timber volume in Washington and third in Oregon, although in the latter state its volume is far exceeded by that of Douglas-fir (*23*). Western hemlock has many admirable qualities for both lumber and pulp production, and has a latent potential for plywood manufacture that is gradually being developed. In both British Columbia and Alaska western hemlock is currently the major pulping timber. A recent report by Erickson (*10*) shows that hemlock comprised 53 percent of the volume of wood used for pulp in the state of Washington in 1956. It is the preferred species on the Pacific Coast for sulfite pulping, particularly for dissolving grades. In all commercial pulping methods, chemical and mechanical, it produces a satisfactory yield of high quality pulp.

Current interest in the management of young timber stands, particularly as to improving the growing stock, has included consideration of western hemlock (*22*), which often grows in nearly pure stands, as well as in mixture with Douglas-fir, *Abies* spp., western redcedar, Sitka spruce, and other species. Authoritative publications on the growth and yield of western hemlock are available (*2, 17*). Comparatively little data are available, however, concerning specific gravity and tracheid length variations within second-growth stands of this species. This paper includes results from a study undertaken to test the effect of thinning in 60-year old stands of Douglas-fir and western hemlock. Material was available from the trees removed in the thinning operation. Those trees remaining in the stand will be tested for response to release by thinning.

Materials and Methods

Cross-sectional disks were removed at stump height, mid-length of the merchantable stem (about one-third total stem length), and at a 5-inch top. Specific gravities were determined, using the conventional water-immersion method, from wedge-shaped pieces that included the pith. Compression wood was avoided in so far as it was visible. Some 39 trees were sampled, representing site indices from 90 to 160, and crown classes of dominant, codominant and intermediate. (See Tables 1 and 2.) The amount of summerwood on each cross section was measured by macroscopic methods. It is recognized that such estimates lack the precision obtainable by microscopic methods but in the case of wide-ringed Douglas-fir at least, have a fair degree of accuracy (*20*). Results for this study, however, indicate that macroscopic de-

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TABLE 1.—SUMMARY OF MEAN SPECIFIC GRAVITY AND RATE OF GROWTH OF TREE SECTIONS OF WESTERN HEMLOCK FROM PERMANENT SAMPLE PLOTS

Permanent sample plot no.	Site index	Average total age	No. of samples	Mean specific gravity oven-dry volume			Average rate of growth (Rings per inch)		
		Years		*Base*	*Middle*	*Top*	*Base*	*Middle*	*Top*
106	90	62	8	.539	.470	.460	13.6	11.8	11.2
104-5	110	60	4	.536	.456	.451	13.4	10.0	9.9
109	120	59	5	.504	.446	.440	11.1	10.1	9.6
101	140	78	11	.526	.463	.466	14.2	12.5	12.5
108	160	56	11	.465	.434	.426	8.2	7.4	6.6
Mean				.509	.454	.448			
Number			39						

TABLE 2.—SUMMARY OF MEAN SPECIFIC GRAVITY BY SITE INDICES AND CROWN CLASSES FOR TREE SECTIONS OF WESTERN HEMLOCK FROM PERMANENT SAMPLE PLOTS

Permanent sample plot no.	Site index	Mean specific gravity (Oven-dry volume) Dominants Base	Dominants Middle	Dominants Top	Dominants No. of samples	Codominants Base	Codominants Middle	Codominants Top	Codominants No. of samples	Intermediates Base	Intermediates Middle	Intermediates Top	Intermediates No. of samples
106	90	.516	.440	.440	3	.560	.501	.494	3	.540	.470	.440	2
104-5	110	—	—	—	—	.532	.453	.434	3	.545	.463	.501	1
109	120	—	—	—	—	.520	.447	.431	3	.475	.445	.454	2
101	140	—	—	—	—	.495	.436	.427	2	.533	.469	.474	9
108	160	.462	.425	.429	5	.467	.438	.423	6	—	—	—	—
Mean		.482	.433	.433		.508	.453	.439		.523	.465	.468	
Number					8				17				14

terminations of summerwood boundaries are not reliable for western hemlock.

Samples for measurement of tracheid length were available from each disk. Small splinters were dissected, from the pith outward, in the fifth, 10th, 15th and 20th annual ring, and from every decadal increment thereafter. These dissected samples were macerated separately, using a method outlined by Kennedy (*13*). A small quantity of the pulp suspension was mounted in glycerine on a glass slide. Ten randomly chosen tracheids were measured on each slide from images projected on a graduated scale (*25*). The reading accuracy of the projection was ± .02 mm., and 10 measurements per slide gave a maximum error of the mean tracheid length of 10 percent, with 98 percent certainty.

Results

Specific gravity. — Examination of Table 1 reveals that the average age of all plots was approximately the same, with the exception of that of site index 140, which was older. There is a consistent decrease in specific gravity from base to top in all plots except the oldest. Likewise there is a consistent decrease in specific gravity from the lowest to the highest site indices sampled, disregarding the older plot. Here an age effect is expected since specific gravity is shown to increase with increasing age in several coniferous species (*21*).

Tests showed no significant differences between average specific gravities of middle and top sections. However those for base *versus* top, and base *versus* middle were highly significant. In order to obtain a more precise measure of specific gravity variation with height in the tree, two trees on site index 90 were sampled at 5-foot intervals. Results are shown in Figure 1, where the expected decrease from base to crown is indicated. Approximate locations of the middle and top (5 in. d.i.b.) sections are marked. Although the data were not analyzed the relationship appears to be linear.

A regression of the effect of site index on specific gravity was calculated for plots of comparable ages. The relationship indicated in Table 1 was highly significant for the basal section. However, the scatter of specific gravity values within each site index was sufficiently great for the middle and top sections so that the regression for these sections was not strong. These analyses are shown in Table 3.

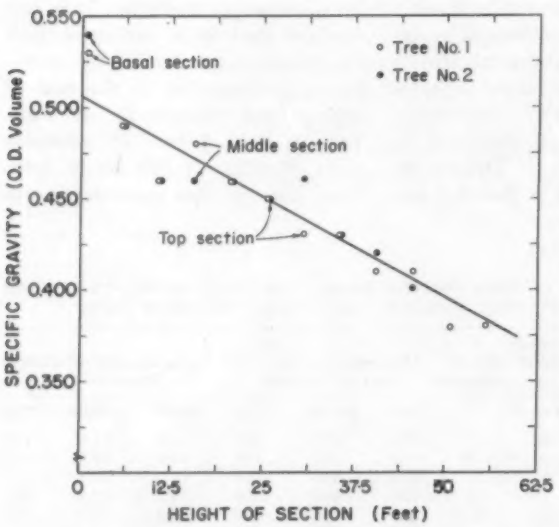

FIG. 1.—Specific gravity distribution of vertical sections in two western hemlock trees on P.S.P. 106.

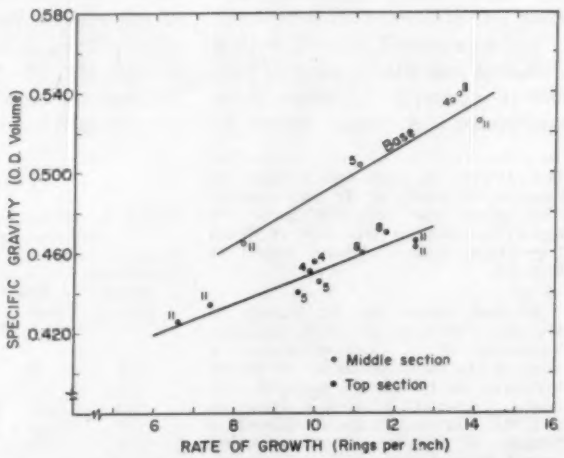

FIG. 2.—Specific gravity-growth rate relationship for base, middle, and top section of 39 western hemlock trees.

In Table 2 are shown the summaries of tests made from samples in the three crown classes on the various sites. Gaps in the data result from the fact that these stands were predominantly of Douglas-fir, and hemlock trees were not always available for removal during thinning. Interpretation of tests of differences between means would be confused by the unbalanced design, and by the site effect indicated above. This site effect is less obvious in Table 2 than in Table 1, but nevertheless is indicated for the codominant crown class. There is a general decrease in specific gravity with improvement in crown class, but differences are not significant. A larger sample would possibly indicate clearer trends.

Various workers have shown a relationship between specific gravity, rate of growth, and percent summerwood (*14, 21*). Summerwood in western hemlock is fairly distinct, although the transition from earlywood to latewood is not as abrupt as in Douglas-fir or the hard pines. A relationship between specific gravity and rate of growth is indicated in Figure 2, where averaged data from Table 1 are plotted. Regression equations were set up to test the effect of percent summerwood and rate of growth on specific gravity. The net effect of including percent summerwood as determined by macroscopic methods, in an estimate of specific gravity, added so little that it could well be omitted. Rate of growth, on the other hand, was highly significant in its effect at each of the three heights. In Table 4 are shown the regression equations and their correlation coefficients. Similarly is noted between equations for middle and top sections. This similarity of data is noted also in Figure 2.

The lack of importance of percent summerwood as a variable affecting specific gravity required further investigation. Chalk and associates at Oxford (11), in studying density in the wood of *Pinus patula*, found a significant relationship between specific gravity, ring width and age. They have also determined the specific gravity of early and late wood in various annual rings, as well as cell wall and lumen thicknesses. Although the

TABLE 3.—ANALYSES OF VARIANCE FOR SPECIFIC GRAVITY BY SITE INDICES FOR TREE SECTIONS OF WESTERN HEMLOCK

(a) Basal section				
Source of variation	D.F.	S.S.	M.S.	F
Between sites	3	28,750	9,583	9.18**
Within sites	25	26,100	1,044	
Total	28	54,850		
(b) Middle section				
Source of variation	D.F.	S.S.	M.S.	F
Between sites	3	5,843	1,948	1.44 N.S.
Within sites	22	29,741	1,352	
Total	25	35,584		
(c) Top section				
Source of variation	D.F.	S.S.	M.S.	F
Between sites	3	5,901.5	1,967	1.56 N.S.
Within sites	24	30,285.5	1,262	
Total	27	36,187		

** = Exceeds mean square error 1 percent level of significance.
N.S. = Not significant at 5 percent level.

TABLE 4.—REGRESSION EQUATIONS AND CORRELATION COEFFICIENTS (r) OF SPECIFIC GRAVITY (Z) ON PERCENTAGE OF SUMMERWOOD (X) AND RATE OF GROWTH (Y), ALONE AND COMBINED, FOR THREE HEIGHTS IN WESTERN HEMLOCK

Section	No. of trees	Z on X alone		Z on Y alone	
		Equation x 10^{-3}	$r_{z.x}$	Equation x 10^{-3}	$r_{z.y}$
Base	39	Z=51.32−0.01485X	−0.078	Z=41.34+0.7633Y	0.642**
Middle	39	Z=43.43+0.05622X	0.105	Z=37.58+0.7175Y	0.505**
Top	39	Z=44.27+0.01851X	0.058	Z=37.16+0.7423Y	0.591**

Z on X and Y combined

		Equation x 10^{-3}	$r_{z.xy}$	$r_{zx.y}$	$r_{zy.x}$
Base	39	Z=42.94−0.0491X+0.7786Y	0.647**	0.105	0.644**
Middle	39	Z=35.78+0.0593X+0.7199Y	0.520**	0.134	0.510**
Top	39	Z=37.75−0.0246X+0.7529Y	0.593**	0.053	0.591**

**=Exceeds means square error 1 percent level of significance.

TABLE 5.—SPECIFIC GRAVITY OF INDIVIDUAL GROWTH RINGS OF WESTERN HEMLOCK RELATED TO PERCENT SUMMERWOOD, AVERAGE CELL WALL THICKNESS, CELL WALL/VOID VOLUME RATIO, RING AGE, AND RING WIDTH

Specific gravity[1] of ring	Percent summerwood (by Mork)	Ave. cell wall thickness (u)		Cell wall void volume			Ring age (years)	Ring width (mm.)
		Springwood	Summerwood	Springwood	Summerwood	Whole ring		
.342	10.5	8.9	8.6	0.34	1.01	0.36	20	4.01
.347	12.9	7.1	7.1	0.25	1.42	0.28	16	3.99
.379	19.9	8.1	9.8	0.30	1.22	0.36	10	3.39
.390	20.5	8.1	8.6	0.35	1.66	0.42	20	3.59
.395	36.3	9.7	10.3	0.45	1.29	0.59	44	0.99
.425	19.9	10.4	10.6	0.44	1.23	0.50	16	2.25
.429	37.1	7.3	8.4	0.27	1.38	0.38	23	1.89
.438	34.1	9.8	12.3	0.50	1.87	0.67	36	0.61
.449	55.6	9.2	10.6	0.46	1.41	0.74	40	0.58
.463	31.8	7.4	10.3	0.32	1.23	0.42	41	2.42
.479	53.2	9.3	9.9	0.43	0.79	0.57	43	0.88
.481	57.7	8.6	9.5	0.27	1.38	0.38	23	1.89

[1]Green volume—oven-dry weight.

TABLE 6.—AVERAGE TRACHEID LENGTH IN MILLIMETERS OF 18 WESTERN HEMLOCK TREES AT THREE LEVELS, FOR FOUR AGE GROUPS, THREE CROWN CLASSES, AND TWO SITE GROUNS

Section	Base				Middle				Top				
Growth ring number	5	10	15	20	5	10	15	20	5	10	15	20	
Site group													*Crown class*
Average	1.92	2.46	2.64	2.96	2.01	2.73	2.89	3.21	1.61	2.32	3.05	3.16	Dom.
	1.82	2.43	2.75	3.02	2.63	3.15	3.57	3.71	2.46	3.16	3.63	3.96	Codom.
	2.00	2.65	2.91	3.07	1.95	2.68	3.35	3.35	2.06	3.15	3.61	3.76	Interm.
Mean	1.91	2.51	2.77	3.02	2.20	2.85	3.27	3.43	2.04	2.88	3.43	3.63	
Good	1.73	2.18	2.68	3.02	2.14	2.73	3.16	3.64	1.96	2.82	3.14	3.60	Dom.
	2.24	2.71	2.95	2.96	2.32	3.11	3.35	3.71	2.50	3.08	3.47	3.95	Codom.
	2.23	2.52	2.50	2.75	2.27	2.90	3.22	3.39	2.22	2.99	3.26	3.51	Interm.
Mean	2.07	2.47	2.71	2.91	2.25	2.92	3.24	3.58	2.22	2.96	3.29	3.69	
Mean	1.83	2.32	2.66	2.99	2.08	2.73	3.03	3.42	1.78	2.57	3.09	3.38	Dom.
Mean	2.03	2.57	2.85	2.99	2.48	3.13	3.46	3.71	2.48	3.12	3.55	3.95	Codom.
Mean	2.12	2.58	2.71	2.91	2.11	2.79	3.24	3.37	2.14	3.07	3.44	3.64	Interm.
Average tracheid length	1.99	2.49	2.74	2.97	2.22	2.89	3.25	3.50	2.13	2.92	3.36	3.66	

early wood—late wood division is shown in various graphs, late wood was not used as a variable in determining density in the species studied.

Percent summerwood in the annual rings should logically have an effect on wood density, therefore tests were made to determine why this factor had proven non-significant in western hemlock. Specific gravities were obtained for individual growth rings, as well as measurements of cell wall thicknesses and lumen diameters on radial lines within the same growth rings. Boundaries between springwood and summerwood were established by Mork's (*19*) standard definition, and percentage of summerwood computed in each growth ring sampled.

It is generally accepted that the density of cell wall substance is constant, and that the difference in density between wood samples is a function of the ratio between cell wall and void volume. Since the growth ring is made up of both springwood and summerwood cells, each has an effect on specific gravity. The reason why neither controls specific gravity closely, at least in a tolerant species such as western hemlock, is that both cell wall thickness and lumen volume vary, as well as the ratio of cell wall to void volume. Examples from the above-mentioned data are shown in Table 5.

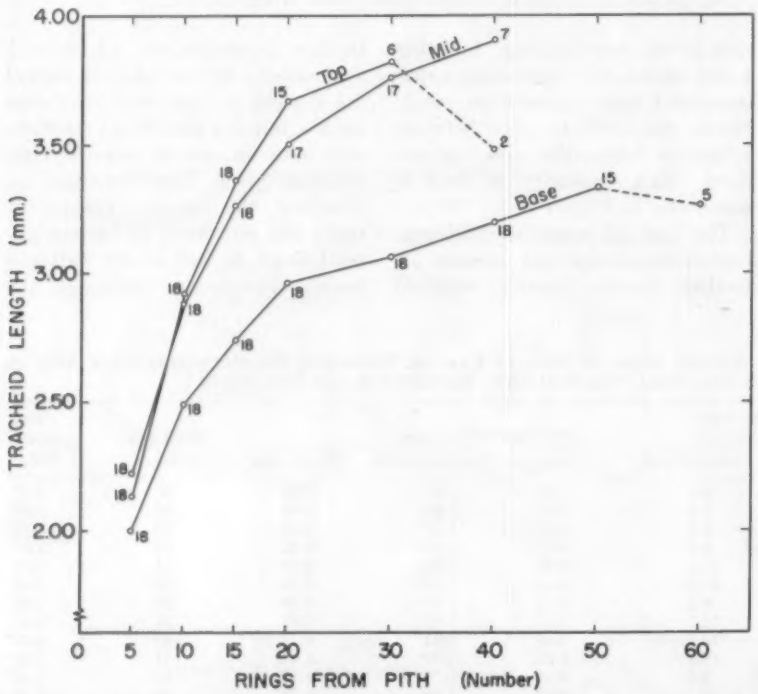

FIG. 3.—Relationship between average tracheid length in millimeters and rings from the pith at three levels in the stem for 18 western hemlock trees.

It is obvious that several of the factors included in the table affect specific gravity, but that none completely control it. Percent summerwood, as measured precisely, has an apparent effect on specific gravity that was not shown when it was estimated macroscopically and averaged over a larger section. The lack of significance of this factor was related more to lack of precision in measurement than to lack of importance as a factor affecting specific gravity. The data for individual growth rings will be analyzed in a later paper.

Tracheid length.—Average tracheid measurements for the top, middle, and basal sections are plotted at their respective ages in Figure 3. The sharp decrease in tracheid length for the top section at 40 years is the result of two trees and does not reflect the general trend of the remaining trees. Summaries of tracheid length measurements at the fifth, 10th, 15th, and 20th ring from the pith at the

base, middle, and top section, for the 18 trees are shown in Table 6. Nine of these were selected from plots whose site indices were in the group from 90 to 120, considered as the Average group of sites, and nine from plots in the group 140 to 160, considered as the Good group of sites. In each group three dominant, three codominant and three intermediate trees were sampled. The twentieth growth ring was selected as the maximum age so as to compare wood having a common number of rings from the pith, at the three sections of the same tree. Basal and middle sections contained more than 20 rings, since total age of the trees was about 60 years, but these results were not used in the above comparison.

A general pattern of increasing tracheid length with age of ring from the pith is noted for most stems. However, the relationship appears to be influenced by such factors as site group, crown class, and position in the tree. The analysis of variance (Table 7) shows the greatest effect for age of ring, which is significant at the 0.1 percent level of probability. This follows Sanio's well established first law.

Vertical position in the stem is highly significant, again as would be expected. The major difference is between the basal section and those sections higher in the tree. There is no significant difference between tracheid lengths at the middle and top sections, for growth rings of the same ring-age from the pith (as distinct from absolute age). These values could be pooled, corresponding to the recommendation made by Anderson (*1*) who based his prediction of tracheid length in Douglas-fir, noble fir and white fir on pooled data that excluded only the basal or stump section. Data shown in Figure 3 would confirm this recommendation. The figure also indicates a major difference between tracheid length at stump height, and higher in the tree. Stump sections represent only a small part of the tree, and have little value for estimating either average tracheid length or specific gravity. Other workers (*9*) have used breast-height samples as more reliable indicators of average conditions within the tree.

Site group had no significant effect on tracheid length and, in fact, the average values for the two groups were remarkably similar (Table 6). Among crown classes the codominant trees had significantly longer tracheid length than either the dominant or intermediate trees. A larger sample might not sustain this superiority of the codominant crown class. There is reason to presume that the dominants would have shorter tracheids due to their more rapid growth and cell division (*3*). It is purely conjecture to presume that the intermediates would have shorter tracheids due to their slower growth rate and lesser vigor. Echols (*9*), however, has shown a relationship between tracheid length and width of growth ring in Scotch pine, wherein the shorter tracheids are associated with slower rates of growth. No such trend is apparent in the writer's data, where only average growth rate of the entire section is available.

A genetic effect of initial tracheid length in the southern pines has been shown by Echols (*8*). Furthermore, Dadswell and associates (*3, 7*), working with *Pinus radiata* and Douglas-fir in Australia, have shown that coniferous trees having initially long tracheids retain this superiority as they grow older, and those having initially short tracheids retain this undesirable characteristic.

When data for western hemlock were segregated by initial tracheid length classes (Table 8) it is seen that tracheid lengths for the basal section vary considerably at the fifth ring. The groups have reached a common level by 15 years, however, and remain about the same in relation to each other. At the intermediate height a greater dissimilarity occurred. The four trees having the shortest tracheids (less than 2.00 mm at the fifth ring)

TABLE 7.—ANALYSIS OF VARIANCE FOR TRACHEID LENGTH DETERMINATIONS IN WESTERN HEMLOCK TREES SAMPLED AT THE FIFTH, 10TH, 15TH, AND 20TH RING FROM THE PITH

x_1 = Site group ..... Average *vs* Good
x_2 = Crown class ..... Dominant *vs* Codominant *vs* Intermediate
x_3 = Position in tree ..... Base *vs* Middle *vs* Top
x_4 = Age of ring ..... 5 years *vs* 10 years *vs* 15 years *vs* 20 years
x_5 = Tree effect ..... From 18 individuals

Source of variation	D.F.	S.S.	M.S.	F	
x_1	1	0.0852	0.0852	0.015	NS
x_2	2	4.9122	2.4561	4.24	*
x_3	2	9.0439	4.5219	7.81	**
x_4	3	46.8713	15.6237	26.99	***
x_5	17	9.8176	0.5775	1.00	NS
Residual	189	110.9690	0.5789		
Total	215	181.3348			

NS = Not significant at 5 percent level.
* = Exceeds mean square error 5 percent level of significance.
** = Exceeds mean square error 1 percent level of significance.
*** = Exceeds mean square error 0.1 percent level of significance.

TABLE 8.—SEGREGATION OF INITIAL TRACHEID LENTH CLASSES FOR TREE SECTIONS OF WESTERN HEMLOCK

Section	No. of samples	Initial tracheid length mm.	Average tracheid length in mm. at growth ring number 5	10	15	20	30	40	50	60
Base	6[1]	1.51-1.80	1.68	2.43	2.73	2.88	3.01	3.16	3.25	3.36
	6[1]	1.81-2.10	1.95	2.43	2.73	2.94	3.09	3.23	3.43	3.20
	6[1]	2.11—	2.34	2.61	2.77	3.04	3.07	3.22	3.35	3.24
Middle	4[1]	<2.00	1.81	2.62	3.16	3.35	3.92	3.66		
	4[1]	>2.40	2.73	3.24	3.51	3.73	4.25	4.15		
Top	4	<2.00	1.58	2.44	3.13	3.42				
	4	>2.40	2.60	3.16	3.56	3.86				

[1]Fewer samples at upper limits of data.

TABLE 9.—COMPARISON OF SECTIONS OF FOUR TREES HAVING SHORT OR LONG INITIAL TRACHEID LENGTHS

Tree number	Section	Initial tracheid length	Average tracheid length in mm. at growth ring number							
			5	10	15	20	30	40	50	60
9-934	Base	Among longest group	2.24	2.60	2.76	3.00	3.14	3.46	3.68	
	Middle	Shortest of group	1.64	2.54	3.14	3.24	3.86	3.46		
	Top	Among shorter group	1.90	2.92	3.76	3.76	3.74			
1-29	Base	Longest of group	2.68	3.01	3.04	3.33	3.42	3.37	3.67	3.46
	Middle	Second longest of group	2.73	3.46	3.86	4.07	4.80	4.37		
	Top	Among longer group	2.27	3.01	3.66	4.34	3.77			
6-981	Base	Second shortest of group	1.61	2.30	2.58	2.74	2.80	2.83	2.74	
	Middle	Second shortest of group	1.86	2.70	2.92	3.08	3.76	3.85		
	Top	Second shortest of group	1.54	1.73	2.87	3.31				
4-538	Base	Among shortest group	1.75	2.58	2.95	2.79	2.90	3.14	3.65	
	Middle	Longest of group	3.05	3.59	3.61	4.05	4.29			
	Top	Longest of group	2.74	3.50	3.78	4.15				

remained shorter throughout the period tested than the four trees having the longest tracheids (greater than 2.40 mm at the fifth ring). Of the four trees having the shortest tracheids, two were dominants and two intermediates. Of those having the longest tracheids, three were codominants and one was an intermediate.

Tracheid lengths at the top sections were compared in a similar manner. It should be noted that the four trees having the shortest initial tracheids at the top section, and the four trees having the longest initial tracheids, did not always correspond to those selected for the same comparison at the middle section or at the basal section. An example is given in Table 9, where certain trees having short initial tracheids or having long initial tracheids are compared in all three vertical sections. A generalization can be made that a western hemlock tree having either initially long or initially short tracheids will retain that characteristic, but it does not appear to be an absolute rule in the data above.

Discussion

It is apparent that in the above data rate of growth is the factor having the greatest effect on specific gravity in western hemlock. Increase in rate of growth of the tree results in a perceptible decrease in specific gravity of the wood. Shown in Table 10 are sample calculations from the regression equations of Table 4, for selected rates of growth. Results for middle and top sections are to all intents the same.

Comparisons can be made between the values in Table 10 and others established for the species. It is stated that the average specific gravity for western hemlock in British Columbia is 0.47, on the oven-dry volume basis, and the average rate of growth 19 rings per inch (*5*). The corresponding formula value for this rate of growth would be 0.51. Comparable data for hemlock grown in the western United States and Alaska (*15*) show an average specific gravity of 0.44, and rate of growth of 17 rings per inch. The corresponding formula value would be 0.50. Forest products laboratory data are normally collected from mature trees from a wide range of sites, hence the above comparisons are not fully pertinent.

McGovern and Chidester (*6, 16*) have compared sulfite pulps from the top, middle, and butt logs of western hemlock of four growth types, namely rapidly grown and slowly grown young growth and old growth. For comparable rates of growth, and therefore excluding the most slowly grown old-growth samples, there is close similarity between the two sets of wood density figures, as shown in Table 11. The above workers found appreciable differences in the yield and quality of the pulps from the different portions of the trees, and between the growth types. The greatest yield was obtained from the butt log, and the least from the top log. Among second-growth logs those of slower growth rate had higher densities and gave higher yields than those of a more rapid growth rate. These workers also show a graphical relation between density and percent springwood in the annual rings, and between percent springwood and growth rate. Their data were limited to five trees. Both of these relationships were absent from the writer's data which were, however, restricted to a narrow age group.

It is not suggested that the forester favor slow growth rates, *per se*, even though wood strength and digester yields both improve as growth rate decreases. Under most present forest management plans and economic transactions, wood volume is of greater importance than wood density, so that a compromise must be reached between the most desirable rates of growth and the resulting specific gravities and wood volumes.

The effect of specfic gravity on wood strength and pulp yield is well recognized. It is also well established that fibril angle has a direct effect on mechanical strength, pulp quality, and wood shrinkage. On the other hand it is not fully established that cell length has a direct effect on wood strength. Wardrop (*24*), however, has shown a relationship between cell length and micellar (fibril) angle, and micellar angle and tensile strength in certain coniferous species in both wood specimens and in isolated tracheids. Several other workers, including Echols (*8*), have shown a relationship between fibril angle and tracheid length, so that the effect of

tracheid length on wood properties is indirect if not direct. Its effect on tensile strength of pulp fibers is direct.

There is active current interest in wood-quality studies, mainly related to tree improvement of the more important coniferous species, but not restricted to them. In a recent paper Mitchell (*18*) states: "At the Forest Products Laboratory, most wood-quality ratings of the softwood species . . . are based upon two key quality indicators—specific gravity and fibril angle. . . ." Dadswell (*7*), in expressing the opinion of Australian workers, makes the following statement: "The average cell length is . . . one of the most important structural features related to quality and utilization, and one of the easiest to measure." Neither of the above authorities has ignored the importance of tree form and other external features in tree improvement work.

Conclusions

1. Specific gravity in western hemlock is maximum at the base of the tree and minimum at the top. The difference in specific gravity between middle and top sections was shown as not significant, but would seem to be real in samples taken at regular intervals vertically in the stem.

2. Crown class has no significant effect on specific gravity, but a trend is suggested.

3. Site index had a significant effect on specific gravity at the basal section. The relationship was inverse with specific gravity decreasing with increase in site index. The effect was not significant at the middle or top sections.

4. Percentage of summerwood in the annual ring, as measured by macroscopic methods, had no apparent effect on specific gravity. When individual growth rings were examined by microscope, a relation seemed to exist. Macroscopic methods of estimating percent summerwood lack precision, due to the character of growth rings in a tolerant species.

5. Rate of growth has a major effect on wood density in western hemlock. A regression equation was determined that gave estimated values of specific gravity within reasonable proximity to values established elsewhere.

6. When an analysis of variance was made of the factors affecting tracheid length, age of the growth ring (in rings from the pith) had the strongest effect. This is in accordance with Sanio's first law.

7. Tracheids were significantly shorter at the base than at middle or top sections, for growth rings of the same ring number from the pith. For heights above the base tracheid lengths can be pooled.

8. Site had no effect on tracheid length.

9. Crown class had an apparent effect on tracheid length. Codominant trees had significantly longer tracheids than either dominant or intermediate trees for the same ring number from the pith.

10. There is an apparent genetic effect whereby trees having tracheids either initially shorter or longer than average will retain that feature as they continue to grow.

11. The results in general shown for western hemlock indicate that the quality of the wood is variable. Furthermore, many of the factors affecting variability are subject to silvicultural control.

Summary

Western hemlock is an important timber-producing species of the Pacific Northwest. Although data for forest inventory, and growth and yield, are available there is comparatively little information on wood characteristics.

Cross section disks at three vertical levels in the stem were available from 39 trees representative of 60-year old stands. Three crown classes were represented, and five site indices. Data from specific gravity determinations showed maximum values at the base and minimum values at the top section. Percentage of summerwood in the growth ring, as determined by macroscopic methods, had no significant effect on specific gravity but rate of growth had a highly significant effect. A regression equation for specific gravity and rate of growth checked reasonably closely with other published data.

Tracheid length measurements were made in 18 trees, at every fifth, 10th, 15th and 20th ring from the pith and every decadal ring thereafter, at three different heights in the stem. Of the variables tested, age from the pith had the greatest effect on tracheid length. Site had no effect whereas crown class had an effect, tracheid length being maximum in codominant trees. A genetic effect is apparent when tracheid lengths at the fifth

TABLE 10.—SPECIFIC GRAVITIES AND ESTIMATED WOOD DENSITY FROM THE REGRESSION EQUATIONS FOR BASAL, MIDDLE, AND TOP SECTIONS, FOR SELECTED GROWTH RATES

Rate of growth	Basal section		Middle section		Top section	
Rings per inch	Specific gravity[1]	Wood density[2]	Specific gravity[1]	Wood density[2]	Specific gravity[1]	Wood density[2]
		Lb. per cu. ft.		*Lb. per cu. ft.*		*Lb. per cu. ft.*
5	.452	24.7	.412	22.5	.409	22.4
10	.490	26.8	.448	24.5	.446	24.4
15	.528	28.8	.483	26.4	.483	26.4
20	.566	30.9	.519	28.4	.520	28.4
25	.604	33.0	.555	30.4	.557	30.4

[1]Based on oven-dry volume.
[2]Based on a shrinkage factor of 12 percent, green to oven-dry, and a green moisture condition.

TABLE 11.—DENSITY OF WESTERN HEMLOCK WOOD IN THE MIDDLE LOG AS ESTIMATED BY THE REGRESSION EQUATION, AND AS REPORTED BY CHIDESTER AND MCGOVERN (*6*)

Rate of growth	Wood density lb. per cu. ft.	
Rings per inch	Estimated[1]	Reported
4.5	22.3	22.3
9.4	24.2	23.6
14.0	26.1	23.0
23.9	30.0	27.6

[1]Based on oven-dry volume, shrinkage factor green to oven-dry of 12 percent, and a green condition.

annual ring, and later, are compared.

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Watershed Disturbance From Tractor and Skyline Crane Logging

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As logging operations in the West continue to move further into the mountains, an increasing volume of timber is being harvested from steep slopes. In these areas, where access is more difficult, road-building costs are greater. And on precipitous mountainsides, soil normally disturbed in logging is more susceptible to damaging slough and erosion. Because of these problems, many acres of timberland are considered inoperable with conventional logging methods.

Methods and equipment that will surmount some of these difficulties are available. Various overhead cable systems have been used in America for many years. Recently, interest has been centered in modified forms of skyline logging, prompted by the development of several European systems that combine the principles of high-lead logging and aerial transportation. One of these, which has been tested in several places in the United States and Canada, is the Swiss-developed Wyssen Skyline Crane.

One demonstration of the Skyline Crane was started October 1954 in a mixed conifer stand typical of the eastern flanks of the Cascade Range in Washington. Performance was good enough to warrant further tests, now being planned, and to encourage the adoption of modified skyline systems. For example, two recent contracts for sale of timber in rough, broken areas of the Cascades have prescribed logging methods similar to those of the Skyline Crane. Purpose of this requirement is to provide a means of satisfactorily harvesting a valuable resource on erosive soil types and otherwise inoperable terrain.

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Relatively few studies have been made in the Northwest to determine the amount of soil disturbance caused by logging. Prior to introduction of the Skyline Crane, Garrison and Rummell (*2*) examined forest-range conditions following logging in eastern Oregon and eastern Washington. They found that exposure of mineral soil averaged 20.9 percent of areas logged with tractors, 15.2 percent of areas logged with cables (jammer), and 11.8 percent of areas logged with horses. Fowells and Schubert (*1*) found 22 percent bare ground following removal of 40 to 90 percent of a stand in the California pine zone logged by crawler tractor.

Soil disturbance caused by skyline logging in the Northwest has apparently not been measured, but an opportunity was provided by the trial operation of the Skyline Crane. In August 1957, after logging was completed, the study described herein was made to determine the extent and severity of soil disturbance. For purposes of comparison, similar measurements were made on a nearby area logged by a standard tractor operation.

As a secondary feature, damage to residual trees by the two logging methods was also examined.

Study Areas

Both study areas are located on the Okanogan National Forest in north-central Washington, near the town of Twisp. Elevations on the area logged by the Skyline Crane range from 3,000 to 5,000 feet; on the area logged by tractor, from 2,000 to 3,500 feet. General topography of the tractor area is more moderate, although in both operations slopes in excess of 60 percent were logged. A slightly smaller volume of timber was available on the tractor area and the cut per acre was consequently smaller (Table 1).

Keen's (*3*) tree classification was used as a basis for marking ponderosa pine (*Pinus ponderosa*) for cutting in both logging areas. In general, all class 4 trees and all class 3 trees except those of good thrift were marked for cutting. Class 1 and class 2 trees were left unless they were defective. On the Skyline Crane study area, 90 percent of the Douglas-fir (*Pseudotsuga menziesii* var. *glauca*) and

Table 1.—Comparative Data For Areas Logged By Skyline Crane and By Tractor

Item		Skyline Crane area	Tractor area
Size of area	Acres	1,000	750
Total stand volume	M b. m.	8,973	5,547
Ponderosa pine	"	6,030	4,540
Douglas-fir	"	2,034	1,007
Western larch	"	909	0
Average volume per acre (before logging)	"	9.0	7.4
Total volume cut	Percent	81	65
Average volume cut per acre	M b. m.	7.3	4.8
Average volume per acre (residual stand)	"	1.7	2.6

FIG. 1.—Basic unit of the Wyssen Skyline Crane is the model W-60 yarder—a 55-horsepower, 4-cylinder, air-cooled diesel engine with a single operating drum. The unit operates from ridgetops, lowering logs by gravity to a landing.

FIG. 2.—In the Wyssen Skyline Crane system, logs are yarded to a skyline and the choker is automatically locked to a traveling carriage for gravity transport to a landing. Another locking mechanism stops ascent of the carriage anywhere on the skyline and holds it while a turn is yarded.

western larch (*Larix occidentalis*) was marked for cutting. On the tractor area, all Douglas-firs of poor thrift or vigor and those with 50 percent or more of the crown infected with mistletoe were marked. No western larch was present in the tractor area.

Logging Methods

Skyline Crane.—The Wyssen Skyline Crane has been described in detail by Matson (*4*), and will be reviewed only briefly here. The basic unit is a single-drum yarder powered by an air-cooled, 4-cylinder diesel engine (Fig. 1). The yarder operates from the ridgetop, lowering logs to the landing by means of a traveling carriage on a fixed, 1-inch-diameter skyline cable. A single operating cable yards logs to the skyline, where the choker locks to the carriage by a special hooking device (Fig. 2). Then the carriage is released and travels by gravity down the skyline. The operating line and a large air-cooled brake on the yarder control the speed of the carriage and its turn of logs as they descend to the landing (Fig. 3).

Slightly more than 1 mile of truck road was constructed in the 1,000-acre area logged by the Skyline Crane. In contrast, it was estimated that 10 miles of road (including spurs) would have been needed for logging by any standard method.[1]

Tractor-arch.—A nearby area selected for comparison was logged with a typical tractor-arch combination. Numerous landings were located along 4.1 miles of truck road. An additional 4.5 miles of main-haul tractor road was used for skidding logs to the landings.

Study Methods

Estimates of soil disturbance in the two logged areas were based on measured samples along 3-chain transects extending from points established on a base line. Tran-

[1]U. S. Forest Service. Timber Sale Report, Jack Creek Area, Okanogan National Forest (1954). (Unpublished report; copy on file at regional office, Portland, Ore.)

sects were spaced at 5-chain intervals and oriented by compass bearings paralleling the general contour. Along each transect, soil disturbance was classified and the lineal extent of each class measured with a tape to the nearest tenth of a foot. These measured lengths were then converted to percentage of total transect length. Transects and the 5-chain distances between them were paced.

Three classes of disturbance caused by yarding and skidding operations were defined. They were adapted from Garrison and Rummell, with slight modification:

1. *Litter disturbance.* Indicated by breaking down of brush or reproduction and disturbance to litter cover, but without removal of litter and soil cover.

2. *Shallow soil disturbance.* Indicated by removal of ground vegetation, litter, and humus, exposing the mineral soil to a depth of less than 1 inch.

3. *Deep soil disturbance.* Same type of disturbance as class 2, but indicated by removal of soil to depths greater than 1 inch.

Observations for damage to residual stands were made in strips along each transect. All trees over 6 inches d.b.h. within 6.6 feet of the compass line were tallied and checked for crushing and breakage in the root systems and crowns and for scarring of the main stems.

Results

Results from 131 transects indicate that both shallow and deep soil disturbance are significantly less in areas logged by Skyline Crane than in comparable areas logged by tractor (Table 2). Differences in litter disturbance by the two methods, however, are not significant. Some soil disturbance was recorded on 91 percent of all 3-chain transects in the tractor area, compared with 78 percent in the Skyline Crane area.

Tractor logging also caused more damage to the residual stand. A tally of the number of damaged trees showed that 21 percent were affected by tractor logging whereas only 13 percent received similar damage on the Skyline Crane area. Damage to the residual stand was found on 60 percent of all sample strips in the tractor area and on 30 percent of those in the Skyline Crane area.

FIG. 3.—A turn of logs arrives at a landing on the Skyline Crane area. Note the two skyline clearings, or "roads," in the background. The stand shown is residual.

Discussion

The most conspicuous effect of logging in both areas is the exposure of mineral soil. This disturbance is not necessarily synonymous with damage. Still, because it represents a potential source of erosion, the comparative extent of exposed soil is the most significant result of the study. Add the percentages of shallow and deep soil disturbance shown in Table 2, and it becomes evident that tractor logging left exposed mineral soil on 22.2 percent of the area, compared with 5.4 percent left by the Skyline Crane.

It is interesting to note that total area of soil disturbed by tractor logging in this study agrees closely with values reported by Garrison and Rummell and by Fowells and Schubert. Differences in topography, soils and timber stand conditions prevent direct comparisons but, significantly, in these three independent studies soil disturbance by tractors falls within the relatively narrow range of 20.9 to 22.2 percent. If 20-percent disturbance is assumed, tractor logging leaves about 128 acres of bare soil per section compared with about 35 acres for the Skyline Crane. (Based on the study by Garrison and Rummell, jammer and horse logging can be expected to expose about 97 acres and 75 acres of soil, respectively.)

The extent of litter disturbance caused by tractor logging was not significantly greater than that

TABLE 2.—AVERAGE PERCENTAGE OF DISTURBANCE ON AREAS LOGGED BY TRACTOR AND BY SKYLINE CRANE, BY CLASS OF DISTURBANCE

Logging method	Class of disturbance[1]			
	Litter	Shallow soil	Deep soil	Total disturbance
Tractor (67 transects)	7.2	6.3	15.9	29.4
Skyline Crane (64 transects)	5.7	2.2	3.2	11.1
Difference	1.5	4.1**	12.7**	18.3**

[1]See "Study Methods" in text for definition.
**Significant at 99-percent level of probability.

caused by the Skyline Crane. In both study areas about equal volumes of timber were removed, so one might expect about 7-percent litter disturbance when 70-80 percent of the timber stand is harvested. Since the soil surface remains covered with litter, this type of disturbance is considered unimportant in assessing effects of logging on watershed conditions.

An important phase of logging disturbance is the manner of crossing intermittent and permanent drainages. Though no quantitative data were taken, observations were made comparing this factor in the two logging areas. Many turns of logs were transported by the Skyline Crane across a stream channel without causing disturbance. In general, drainage crossings in the area logged by tractor were well planned, but even with the best of precautions the crossings still constituted a source of silt and debris during periods of runoff.

It is generally recognized that construction and use of logging roads contribute a large part of stream sediment. Logging with the Skyline Crane required about 10 percent of the truck road system estimated to be necessary for logging the same area by standard methods.

Summary

In a comparative study of logging methods, soil disturbance caused by a Wyssen Skyline Crane was only a quarter of that caused by a standard crawler tractor operation. Soil disturbance on the Skyline Crane area was found on fewer transects, less damage was evident in the residual stand, and less road construction was needed. These advantages suggest the possibility of using skyline logging systems for harvesting timber in municipal watersheds and other areas previously closed to logging because of erosive soil conditions or steep, broken terrain.

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Some Effects of Stand Density in A Red Pine Plantation on Soil Moisture, Soil Temperature, and Radial Growth

Lino Della-Bianca and Robert E. Dils

THINNING of dense, even-aged forest stands is commonly practiced to increase the rate of growth, improve composition and grade, and obtain greater total yield by recovering and using material which would otherwise be lost. Whether the increase in growth after thinning is due to more favorable conditions of light, microclimate, soil moisture, or a combination of factors is uncertain. During 1953 studies were conducted in a 39-year-old red pine (*Pinus resinosa* Ait.) plantation in northern Lower Michigan to measure the influence of varying stand densities on soil moisture, soil temperature, and radial growth.

This plantation is in southwestern Crawford County near Higgins Lake. The soil is a weakly developed podzol, sandy in texture, which exhibits very rapid drainage and very low moisture-holding capacity. The typical profile has a litter layer of pine needles about 1 inch deep; a dark-grey, almost black, humus layer ¼ to ¾ inch thick; a greyish-yellow A_1 horizon to a depth of about 8 inches; and a light reddish-brown to reddish-yellow B horizon to approximately 23 inches. The mineral soil is a coarse sand throughout. A C horizon of coarse pale-yellow sand with occasional inclusions of finer texture material underlies the solum. Probings to depths in excess of 11 feet revealed no high or perched water table.

The climate of the area is characterized by a well distributed mean annual precipitation of 30 inches including an average of 78 inches of snow, a mean annual temperature of 42° F., and a growing season of approximately 115 days. The summer season is generally mild; the winters are cold. Relative humidity is moderate to high, and evaporation rates are generally low.

THIS STUDY was conducted under a cooperative grant-in-aid project between the Lake States Forest Experiment Station, Forest Service, U. S. Department of Agriculture, and Michigan State University Agricultural Experiment Station. At that time the authors were respectively graduate student and associate professor, Department of Forestry, Michigan State University; present positions are research forester, Southeastern Forest Experiment Station, and Pack professor of watershed management, Colorado State University.

Methods

The red pine plantation was established in 1914 with a spacing of 5×5 feet. In 1951 the stand was thinned to different stocking levels. An unthinned plot containing 190 square feet of basal area per acre was retained.

Compartments with residual stand densities of 80, 120, and 190 square feet of basal area per acre and an open field adjacent to the north of the plantation were selected for this study. The cover on the open field consisted of grasses, sweet fern, and widely scattered jack pine. Three 1/5-acre subplots, each with a surrounding ½-chain

TABLE 1.—VARIANCE RATIO (F) BASED ON ANALYSIS OF VARIANCE FOR SOIL MOISTURE DATA BETWEEN STOCKING LEVELS OF THE RED PINE PLANTATION, 1953[1]

Date		6-inch depth		18-inch depth		36-inch depth	
		F	*Sig.*	*F*	*Sig.*	*F*	*Sig.*
Feb.	28	1.62	N.S.	8.86	*	5.82	*
Mar.	26	0.57	N.S.	0.53	N.S.	6.40	**
April	1	2.89	1	5.82	*	8.01	**
	18	0.05	N.S.	3.74	*	0.93	N.S.
May	2	2.39	2	2.92	1	3.54	1
	9	12.90	**	0.22	N.S.	0.37	N.S.
	16	14.70	**	0.94	N.S.	0.69	N.S.
	23	2.00	2	1.41	N.S.	0.06	N.S.
	30	0.27	N.S.	0.64	N.S.	0.11	N.S.
June	6	1.24	N.S.	2.75	1	2.71	1
	13	2.98	1	0.03	N.S.	1.24	N.S.
	20	5.31	*	0.97	N.S.	4.32	*
	27	2.95	1	1.58	N.S.	0.49	N.S.
July	4	1.64	N.S.	0.04	N.S.	3.40	1
	11	7.24	**	0.54	N.S.	0.37	N.S.
	18	1.18	N.S.	0.57	N.S.	2.54	2
	25	2.45	2	6.74	**	1.71	N.S.
Aug.	1	12.80	**	1.14	N.S.	0.53	N.S.
	8	3.02	1	1.40	N.S.	2.73	1
	15	2.40	2	1.29	N.S.	3.97	*
	22	4.34	*	2.45	2	3.52	1
	29	1.40	N.S.	2.67	2	2.31	2

[1] **=significant at 1-percent level; *=5-percent; 1=10-percent; and 2=20-percent level. N.S.=not significant.

isolation strip, were established within each compartment. Gravimetric soil samples were collected at biweekly intervals from February to May of 1953. Thereafter samples were taken at weekly intervals until September. Six randomly selected samples were collected from the 4.5-7.5, 16.5-19.5, and 34.5-37.5-inch depths of each compartment. The mean value of each range in depths (6, 18, and 36 inches, respectively) appears on Figures 1 and 3. At these same levels, instantaneous soil temperatures were measured from soil pits with soil thermometers. Sampling depths were selected after consideration of root distribution and soil profile characteristics.

Radial growth was measured on 12 dominant and codominant trees in each compartment with a dialgage dendrometer. These measurements as well as those of soil temperatures were made at the same time that soil samples were extracted except that the radial growth measurements were not started until May 2.

The analysis of variance was used to determine the statistical significance of differences in soil moisture, soil temperature, and radial growth between compartments.

Soil Moisture

The set of curves in Figure 1 shows the soil moisture regime from the time of maximum recharge in the spring to the extreme dryness in late summer.

The moisture content in the unthinned stand (basal area of 190 square feet per acre) at all three depths was higher than in the thinned compartments and the open field until approximately mid-April. This was probably due to the different rate of snowmelt. Field observations indicate that snow

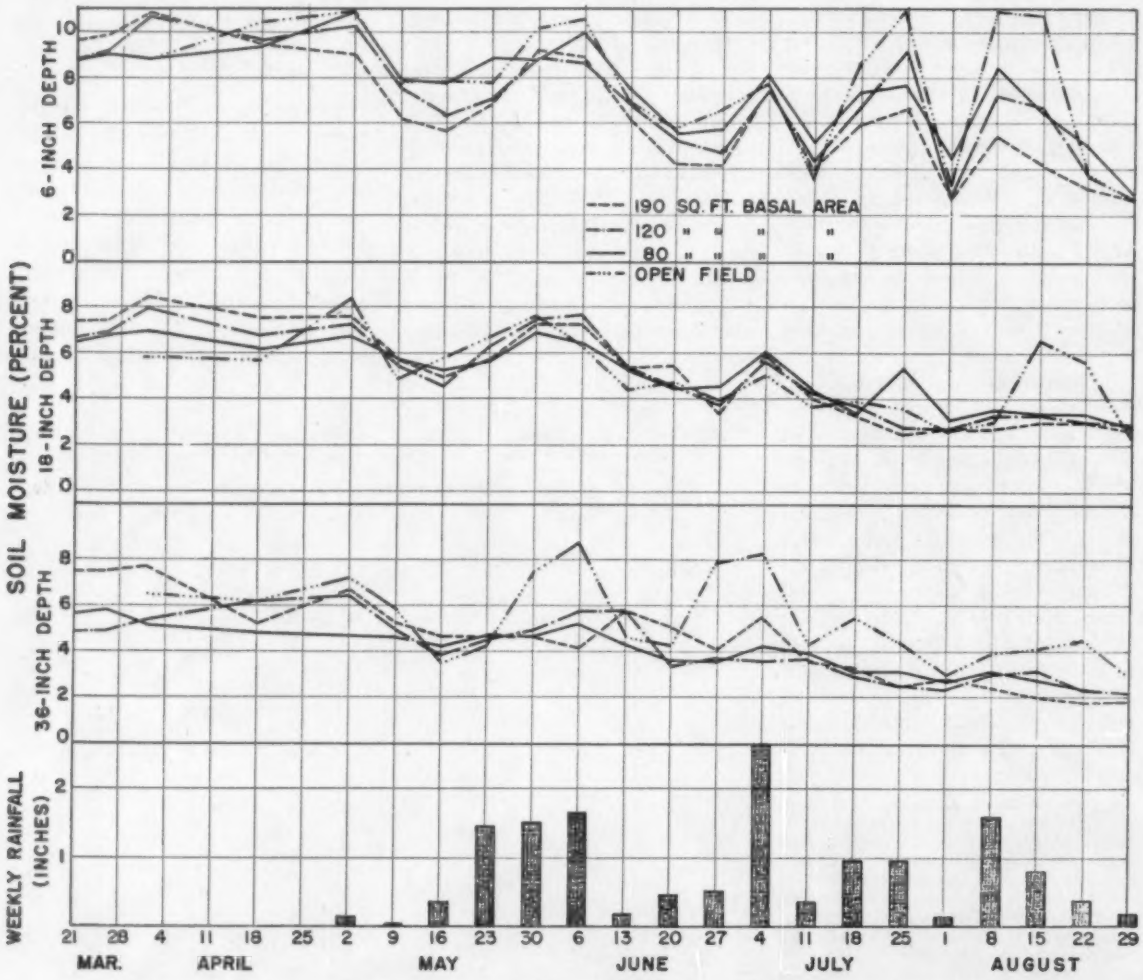
SOIL MOISTURE (PERCENT)
6-INCH DEPTH
18-INCH DEPTH
36-INCH DEPTH
WEEKLY RAINFALL (INCHES)
190 SQ. FT. BASAL AREA
120 " " " "
80 " " " "
OPEN FIELD
21 28 4 11 18 25 2 9 16 23 30 6 13 20 27 4 11 18 25 1 8 15 22 29
MAR. APRIL MAY JUNE JULY AUGUST

FIG. 1.—Soil moisture (expressed as percent of over-dry weight) for three soil depths in a red pine plantation and in an open field, 1953. Measurements taken for February 28 do not appear on chart but were generally somewhat lower than on March 26.

cover remained approximately 1 week longer in the unthinned stand than in the open or heavily thinned stands despite the fact that a dense canopy can intercept nearly half of the falling snow (*3*). Afterwards, the unthinned stand generally had the lowest moisture content at all levels.

The retention of snow cover in the unthinned stand maintains moisture conditions in the underlying soil for a longer time through a gradual addition of snowmelt. Where no snow cover exists, soil moisture depletion from maximum recharge begins as soon as the supply of snowmelt ceases, or sooner, depending on the difference between the rate of snowmelt and the subsurface percolation rate. For the sandy soils of this study, even though more snow fell in the thinned stands, its earlier conversion to melt water resulted in less total subsurface moisture in the succeeding weeks.

The soil moisture differences between compartments are greatest at the 6-inch depth. As Figure 1 indicates, there is an inverse relationship between the soil moisture level and the amount of vegetative cover; i.e., soil moisture increases with decreasing cover. In addition, the soil moisture level at the 6-inch depth shows marked fluctuations in response to summer storms and drying periods. The gradual straightening of the soil moisture curves with increasing depth indicates that summer precipitation is less effective in promoting soil moisture recharge as soil depth increases. The moisture trend in the topsoil during the latter part of the growing season is particularly significant from the standpoint of forest growth because in the deep, loose sandy soils of this area much of the water for growth is contained within the surface foot of soil. As the soil moisture supply

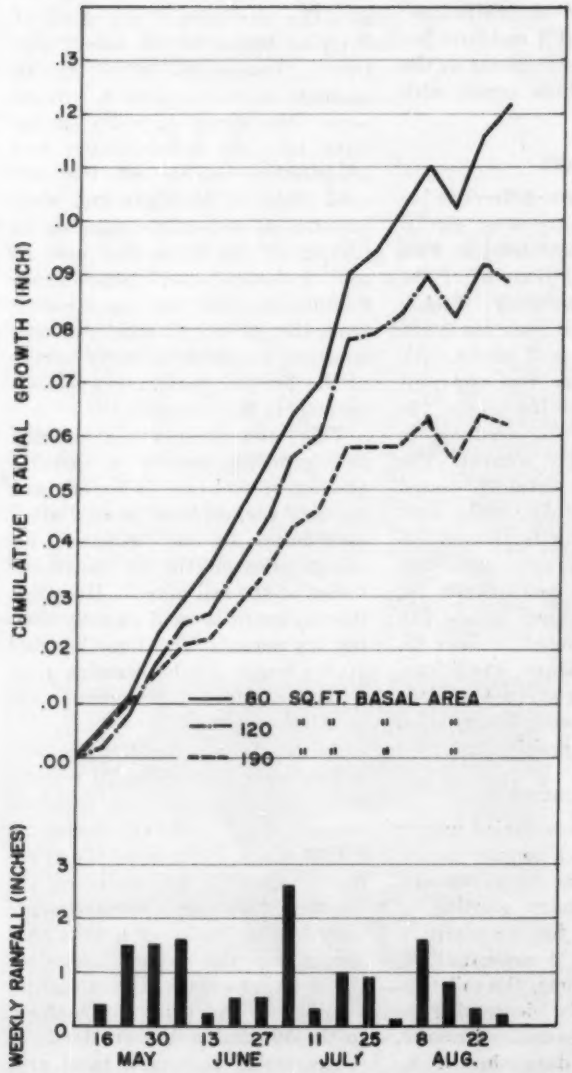

FIG. 2.—Cumulative radial growth is a red pine plantation, 1953.

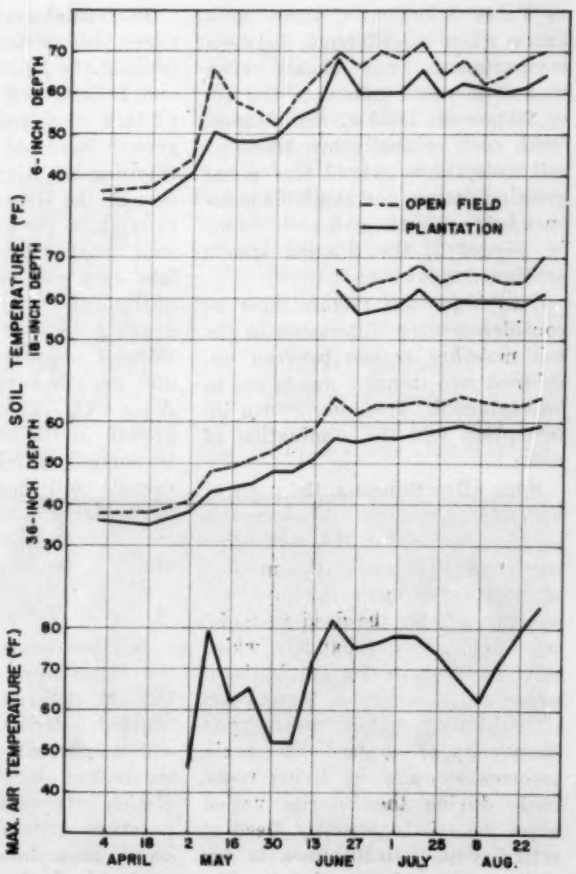

FIG. 3.—Soil temperatures in an open field and a red pine plantation, 1953.

leveled off at the 18- and 36-inch depths on and after July 18 the radial growth rate declined. Thereafter, the soil moisture supply at the 6-inch depth assumed a more vital role in maintaining growth because it was available in greater quantity there than at the 18- and 36-inch depths.

The rooting characteristics of red pine on these dry sand plains bear out the importance of the topsoil moisture supply. Day (*2*) showed for similar soils on the Upper Peninsula of Michigan that lateral and riser roots were concentrated within the surface foot of soil and only sinker roots and the taproot descended below the 1-foot depth. A similar root distribution pattern was found for a dominant red pine in the plantation.

For the 18- and 36-inch levels, the soil moisture curves for the three forested compartments showed little variation; however, as Table 1 indicates, there were times when a difference between compartments was shown even though it was confined to the 10- or 20-percent level of significance. With such critically low levels of soil moisture as existed late in the growing season, any available moisture helps growth; and, as is shown in Figure 2, the thinned stands continued growing.

Two important factors must be considered when differences in the soil moisture regime between unthinned and thinned stands are to be explained. These are crown interception and the elimination of roots.

Soon after thinning, the roots of harvested trees die. This creates growing space for the remaining trees and also lessens the number of roots striving to remove soil moisture. Later the dead roots decay leaving root channels which serve as conduits for gravitational water and sinker roots. Some years after thinning, and depending upon its severity, the ground space again becomes occupied by living roots. It is during the interim period when the soil is partially freed of active roots that increases in soil moisture can be expected. The study by Craib (*1*) bears this out.

Crown interception is responsible to some extent for the amount of precipitation reaching the ground. Hoover (*4*) showed that for a loblolly pine plantation averaging 31 feet in height and containing a basal area of 103 square feet, the net rainfall under the trees averaged about 86 percent of that in the open for rains above 0.30 inch. What the effect would be for larger or smaller basal areas is not known; however, crown interception is probably of less importance than the elimination of root competition in accounting for soil moisture differences between compartments.

Table 1 gives the computed F values for the soil moisture data and shows the level of significance. The difference in soil moisture between depths was significant at the 1-percent level, which agrees with other findings.

Growth

The radial growth difference between compartments was significant at the 1-percent level in 1953 and 1954, 2 and 3 years after the thinning, respectively. Radial growth increased in response to the thinning as Figure 2 shows. Although the increase was apparent throughout the growing season, the most marked increase occurred in late July and early August. The unthinned stand virtually ceased growing by mid-July, while both thinned compartments showed radial growth continuing until late August. This continuation of growth in the thinned stands can be partially attributed to more favorable soil moisture conditions, particularly in the surface soil layers, due to reduced interception and less root competition.

Temperature

Soil temperatures varied among the three forested compartments, but the differences were not significant. Preliminary plotting of soil temperatures for the compartments had shown a consistent variation between them, the soil temperature generally decreasing as basal area increased. However, analysis of the data showed no statistical significance for this trend, so that no biological inference can be made. The soil at the 6- and 36-inch depths was at the approximate minimum temperatures of 47.5° F. and 43° F., respectively, when radial growth began. Throughout the growing season, however, there was a significant difference in soil temperatures between the open field and the forest at all three depths (Fig. 3). These differences were significant at the 1-, 5-, and 10-percent levels, respectively, for the 18-, 36-, and 6-inch depths.

Summary and Conclusions

The results of this study are of value to others besides silviculturists. The total area of dry sands of the pine plains in the Lower and Upper Peninsulas of Michigan amounts to more than 4 million acres. The study provides an insight into the soil moisture and temperature regime of the dry sand plains of Michigan and gives foresters as well as hydrologists an inkling of the highs and lows of soil moisture and temperature fluctuations that may be expected from the period of maximum soil moisture recharge in early spring to the low soil moisture levels occurring in late summer.

This study shows that during the growing season a greater amount of moisture is found near the soil surface and precipitation contributes to soil moisture recharge primarily in the upper few inches of the soil mantle. However, this moisture is used rapidly during dry periods. The depletion rate at the lower depths remains relatively constant throughout the growing season.

At the 6-inch depth there was a significant (up to the 20 percent level) difference in soil moisture between the forested compartments for 13 of the 18 weeks of the growing season. The soil moisture differences between compartments were less at the lower depths and, except for the period preceding the growing season, the statistical significance was generally confined to the 10- and 20-percent levels.

Decreasing the stand basal area rendered an initial supply of soil

moisture available in larger quantities over a given period of time for the remaining trees; during the growing season this temporary increase in available soil moisture of the A horizon contributed to increased radial growth of the thinned stands.

Soil temperatures between the forested compartments were not significantly different, but there was a significant difference between soil temperatures of the open field and the red pine stand.

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The Marden Brush Cutter For Slash Disposal and Ground Preparation

Howard G. Hopkins and Lyle N. Anderson

GROUND PREPARATION prior to tree planting or seeding is often an important initial step toward securing a satisfactory restocking of trees. The required work may involve the elimination of brush competition, logging slash, or other undesirable ground cover.

A Marden Brush Cutter was used on the Rogue River National Forest in the autumn of 1958 to (1) dispose of lodgepole pine slash and residual diseased trees on clearcut units, and (2) to prepare for planting an old burn covered by snowbrush and sedge. Results were considered good on the slash area and fair for brush field conversion. A versatile machine had been sought that would perform this work in a single operation, if possible, and at a low per acre cost.

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The Machine

The machine used was a Model B Marden Brush Cutter pulled by a D-8 Caterpillar tractor (Fig. 1). The brush cutter consists of two hollow steel cylinder-like rollers with cutting bars on the rolling surfaces. The cylinders are about 7 feet long and 4 feet in diameter with 6 cutting bars, each 11 inches high, running the length of the roller. Each cylinder is mounted in a frame-encased axle for pulling, much like a simple pull-type road roller (Fig. 2).

The two rollers are normally hitched in imperfect tandem by use of an offset spacing bar. So mounted, instead of rolling freely as pulled, they roll and slide giving a shearing as well as crushing action to the cutting blades.

The cutter weighs about 15,000 pounds with the drums empty or 25,000 pounds when water filled.

Areas Treated

The slash area treated was on a series of rectangular lodgepole pine clearcut units immediately

FIG. 1.—Tractor and brush cutter as seen from left rear. Note close coupling of cutter units on this side.

FIG. 2.—Cutter units as seen from right side. Note wide coupling of units.

east of Crater Lake National Park, in Klamath County, Ore. The soil is a very light, relatively infertile pumice soil of recent geologic origin. The terrain is flat to gently sloping with maximum slopes of 15 percent. Elevation is about 5,000 feet. About 20 cords per acre of pine pulpwood had been removed from a stand 60 to 80 years of age.

Essentially all live trees over 6 inches in diameter were cut in logging and utilized to a top diameter of 4 inches. Left on the cutover areas were many unmerchantable poles, saplings, and seedlings. Practically all trees left, regardless of age, were infected with dwarfmistletoe. Treatment had two objectives: (1) to eliminate the remaining live trees and thereby remove a source of dwarfmistletoe infection for the next timber crop, and (2) the reduction of fire hazard to a reasonable level, with minimum reduction of the present and potential supplies of soil humus—already very deficient in this soil.

The brush area, the old Woodruff Burn on the Union Creek District, was also on light pumice soil on practically flat terrain. The area had once supported a fine stand of Douglas-fir, ponderosa and sugar pine, but after repeated burns, brush and sedge had taken over and occupied the site for many years. *Ceonothus velutinus* was the principal brush species with a dense mat of the sedge, *Carix inops*, carpeting the spaces between the brush crowns. In spite of repeated tree seed crops around the perimeter, very little tree reproduction had become established. Planting between and beneath the brush had been tried without success. Apparently brush and sedge competed too seriously for the available moisture in the seedling root zone.

It was anticipated that the Marden Brush Cutter would disk up the ground cover and leave a suitably prepared planting site.

Treatment and Costs

Cost of the operation varied slightly between the two areas and consisted of two primary elements: (1) contract rate on an acre basis for Caterpillar D-8 tractor with operator to pull the Brush Cutter, and (2) monthly rental rate for Brush Cutter. The latter amounted to about $3 per acre treated. The bid rate for the tractor was $15 per acre for treating 200 acres of lodgepole pine slash and $12 per acre for treating 100 acres of brushfield. Adding the cutter rental, increases these costs to $18 and $15 respectively. The tractor rate was for single treatment of the area. Double treatment or crossworking of limited areas was ordered and paid for at double the single treatment rate.

Production averaged about 1.5 acres per operating hour. Some operating time was lost on hangups over high stumps. Costs would undoubtedly be reduced for treatment of larger areas as the contractor advised that moving costs, primarily "low-boy" rental, amounted to nearly ⅓ of his total expenses. These included moving the tractor in, between jobs and out, and moving the brush cutter between jobs.

Results

Light lodgepole pine slash was well chopped up and ground well into the soil (Fig. 3.) The soil was "cultivated," with the thin vegetative ground cover broken up. The cutters gridironed the soil with indentations that may have some value for catching and holding moisture and may make favorable protected spots for tree seed to accumulate, germinate and survive. Where slash was heavy or where many unmerchantable 3 inch to 6 inch poles were left, the machine rode down the poles, chopped the tops up, but did not do a completely satisfactory job of slash disposal. Fire would still travel through the slash in treated area, as was discovered during the fall burning of adjacent piled slash. In one instance wind carried the fire from one pile into a brush cutter treated unit. The fire spread rapidly across the entire unit—apparently faster than it would have through an untreated area. This is explained by the fact that the slash left above ground was well compacted and, more important, no green trees or patches of green poles were left on the area to slow the fire—all of this having been changed to a red slash condition. However, because the slash is compacted at the surface or mixed with the soil, rapid deterioration is expected.

FIG. 3.—Area of light lodgepole pine slash following single treatment with brush cutters.

FIG. 4.—Cutters seen working brush and sedge area on old Woodruff Burn.

In general, results in the lodgepole pine slash appear more favorable than could have been achieved by any other equipment with which we are familiar.

Advantages of treatment of the brush and sedge field are less definite. It appears questionable whether the treatment is adequate to provide a satisfactory planting site. One working of the brush cutter did a good job of breaking down the brush crowns but did not dislodge the brush root system nor satisfactorily tear up the sedge ground cover.

A cheaper and more complete job of brush and sedge removal was done on an adjoining portion of the Woodruff burn by windrowing with a bulldozer equipped with brush blade (Fig. 4). At the time of writing it was too early to judge the relative success of the ponderosa pines planted on both areas. Vegetative competition and fire hazard will certainly be lower on the windrowed area. But the humus worked into the soil and the dead shade left on the brush cutter treated area may be a more than offsetting advantage.

It is our opinion that if the Marden Brush Cutter used had been equipped with the regular 12 cutting bars rather than a special adaptation of only 6 cutting bars, we would have secured a better job of sedge eradication, but probably a poorer job of brush and slash disposal. The 12 cutting bars, 11 inches high, used in the light pumice soil should be able to lift and turn the sedge sod entirely over, exposing the roots to the sun.

The 6 cutting bars are favored in heavier bodied material such as the lodgepole pine slash. In this type, more cutting effect is needed and it is desirable to grind the severed material into the soil.

Based on our experience it appears the brush cutter might be advantageous for some other possible uses. While our use was confined to essentially flat land, it seemed it could be used for contour work on slopes up to 10 or 15 percent. It probably would be a very effective (but rather cumbersome) tool for loosening compacted soils on abandoned logging landings, skid roads and logging roads.

Summary

A Marden Brush Cutter pulled by a D-8 tractor was used on Rogue River National Forest to treat lodgepole pine slash on clearcut units with results that appear favorable. Results were less favorable when the same machine was used to prepare a brush field with a sedge ground cover for planting. Cost of treatment varied from $15 per acre for single working of the brush field to about $36 per acre for double or crossworking the slash area. Retention of the humus and potential humus on the site is considered a major advantage of this type of treatment.

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Forest Products Research Society to Hold International Meeting

The 14th annual meeting of the Forest Products Research Society will be held at the Queen Elizabeth Hotel, Montreal, Canada, June 5-9. An attendance of 1,000 is expected.

Some 50 papers will be presented and the sessions will cover the following subjects: Wood Preservation, Packaging, Chemical Utilization, Wood Machining, Wood Finishing, Chemical Utilization, Glues and Gluing, Lumber Manufacturing, Merchandising, Logging, Industry Education, Wood Composition Board, Quality Control, Wood Drying, and Veneers and Plywood.

The Identification and Dating of Past Attacks of the European Pine Shoot Moth on Red Pine

Herman John Heikkenen

SINCE its introduction in the early part of this century, the European pine shoot moth (*Rhyacionia buoliana* [Schiff.]) has proved to be a pest capable of damaging many species of pine grown in the United States. The most seriously damaged host has been red pine (*Pinus resinosa* Ait.). In some areas infested by the shoot moth the planting of red pine has been reduced or discontinued.

Various methods are used to measure the intensity of shoot moth infestations. The insect population is often expressed in terms of the percentage of total shoots infested per tree or a given number of branches. Drooz and Waters (*3*) have subjectively rated the degree of past damage in developing a hazard classification of geographic areas in Pennsylvania. However, a quantitative measurement of the element of time—how long a plantation has been infested—has not been included in survey procedures or research techniques. Perhaps the omission of the time element is based on the widely held premise that once an open young red pine plantation is attacked by the shoot moth, the insect population will invariably build up to a high density within 3 to 5 years. Plantations in which this occurs have been observed in Connecticut by Friend et al. (*5*) and Hawley and Lutz (*7*), and also in Ohio by Miller and Neiswander (*14*). In Michigan, however, many young red pine plantations that have been infested for many years continue to grow at a normal rate both before and after closure.

Knowledge of the age of an infestation would be of value to foresters, especially in determining the feasibility of control measures and timber stand improvement practices. This paper presents a technique for identifying shoot moth damage and dating a specific point of injury, and thereby the initial year of shoot moth attack in a red pine plantation. The technique applies knowledge of the insect's feeding habits and the growth response of the host.

Insect Development

The buds and shoots of the tree provide the insect with food and shelter during the larval and pupal stages. After completing a

FIG. 1.—Three-year-old red pine lateral bud cluster destroyed by the European pine shoot moth (Wexford County, Mich.).

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short needle-mining period, the early-instar larva mines a newly formed bud, beginning in late June and early July. This injury can be termed summer injury. After overwintering in the bud, the late-instar larva becomes active about the middle of April. Spring injury occurs when the larva bores into fresh buds and into the elongating shoot. The insect pupates within the bud and shoot, and the adult emerges after 2 or 3 weeks. The flight period lasts for about a month beginning in mid-June. In North America there is one generation a year. More detailed accounts of the life history can be found in publications by Friend and West (*4*) and Miller and Neiswander (*14*).

Appearance of Shoot Moth Damage

Recognition of past damage rests on a knowledge of the appearance of current damage. Currently infested buds can be detected by resin exudates, frass accumulations, larval entry and pupal emergence holes, and empty pupal skins. In a plantation which has been attacked for several years, the old shoot moth damage can be identified by such symptoms as mined buds remaining on the tree, reductions in the number of branches per whorl, and various kinds of damage to the main stem. Stem damage includes crooks, forks, posthorns, bushy tops, and spike tops. Shoot moth injury up to 34 years old has been identified by use of these characteristics.

Current and recent damage was studied in shoot-moth-infested red pine plantations in Wexford and Ottawa Counties, Michigan. Damage ranging back 12 to 15 years was observed in Washtenaw County, Michigan. To determine the appearance of still older damage, red pine plantations on the Eli Whitney Forest of Yale University and also in plantations of the New Haven Water Company in Connecticut were investigated. These are among the oldest known infestations in North America.

The nature of the damage to the host tree and any losses in form or growth rate are the result of several factors. The main ones are the position of the bud within the bud cluster as well as on the tree, the time of year the bud or shoot is attacked, the extent of the individual insect's feeding, and the subsequent development of the bud or shoot. Following are discussions of injuries characteristic of European pine shoot moth attack which are of value in dating the year of attack.

Pruning.—If the lateral buds in the terminal bud cluster are completely hollowed out and killed either in the summer or in the spring, the result is, in effect, a pruning. The reduction in the subsequent branches in the whorl may

FIG. 2.—The number of branches per fork or the loss of form depends on the number of buds destroyed and the degree of offset. *Left*: 2-year-old fork with shoot-moth-destroyed bud cluster (Wexford County, Mich.). *Right*: 34-year-old crook from the vicinity of New Haven, Conn.

FIG. 3.—A 2-year-old posthorn on red pine, the result of spring feeding of the European pine shoot moth (Wexford County, Mich.).

range from one to complete. Shoot moth pruning does not leave a protruding branch stub, and the wound closes quickly. If all lateral buds of a cluster are killed, the bud-scale scars remain as evidence of the internode until bark sloughing occurs. Damaged lateral buds have been observed to remain on the main stem of red pine for as long as 8 years (Fig. 1). With pruning of the lateral buds there is no development of a crook in the main stem.

Crook or fork.—The terminal bud can be destroyed by summer or spring larval feeding. If undamaged lateral buds are present, a lateral shoot may replace the terminal. The resulting loss of form depends on the degree of offset and the number of lateral shoots that continue height growth. Crooks can also be caused by partial destruction of the developing shoot by spring feeding. When two or more laterals assume dominance, a forked stem is the result. Many variations of crooking and forking can occur (Fig. 2).

Posthorn.—During the spring, late-instar larvae occasionally feed upon the side of the developing terminal bud or shoot. If feeding stops before the shoot is killed, the injured leader often bends at the point of attack. If the injured shoot continues to grow, a characteristic " posthorn" is formed (Fig. 3).

Bush and spike top.—When the terminal and lateral buds on the terminal shoot are destroyed, terminal growth stops and adventitious or latent buds form. If these buds are in turn destroyed, additional adventitious buds will form. A lateral below the "bush" may assume dominance (Fig. 4). This type of damage is perhaps the most reliable indicator of shoot moth damage.

When adventitious buds do not develop, and the insect attack kills the terminal, the dead top is referred to as a "spike top."

Dating the Damage

Damage to the main stem or lateral branches in the form of pruning, crooks, and forking can be dated by determining the number of years represented by the internodes between the terminal and the point of injury. When damage is in the form of posthorns, bushes, and spike tops, the damage may be dated by selecting a relatively undamaged lateral branch below the point of injury, counting back to the main stem the years represented by the internodes, and then proceeding upwards on the internodes of the main stem to the point of injury. Care should be taken to avoid counting false internodes created by "summer shoots." When all lateral branches are badly damaged and the tree is still living, the year in which a specific injury occurred can be found by cutting the stem just below the point of injury and counting the annual rings representing the growing seasons. On older trees, this can be done with an increment borer.

The presence of a bush or spike top indicate the loss of at least a year's height growth, especially if a lower lateral branch does not continue height growth. The number of years in which height growth did not occur can be determined from the age of the stem below and above the point of damage. Age differences greater than 1 year reflect the number of lost years.

Damage By Other Causes

Not all of the deformities likely to be met with in red and other pine species are caused by the shoot moth. Similar injury may be inflicted by other insects, mammals, birds, disease, weather, or man. However, the causal factor can usually be identified, especially if pruning has not occurred or the wound has not been overgrown.

Of the types of damage that might be confused with shoot moth injury, that resulting from attack by the Saratoga spittlebug (*Aphrophora saratogensis* [Fitch]) and the white-pine weevil (*Pissodes strobi* [Peck]) is most likely to be encountered. Spittlebug injury can be differentiated by resin pockets in the phloem of the branches resulting from nymphal feeding punctures, and also by the flagged branches. Weeviling results in dead terminals and can be detected by the presence of adult emergence holes.

Other insect damage is occasionally encountered. Lyons (*10*) has reported that the red-pine cone beetle (*Conophthorus resinosae* Hopk.) kills the shoots of sapling and pole-sized red pine and also overwinters in the vegetative buds. He also states (*11*) that some of the native Dioryctria species occur occasionally in red pine plantations and have caused severe damage along the southern edge of the range of red pine. The larvae of *D. zimmermani* (Grote) (=*D. cambiicola* [Dyar]), according to Munroe (*16*), feed primarily in the pith of the current year's shoots, according to Lyons (*11*). Rennels (*18*) has reported that the Zim-

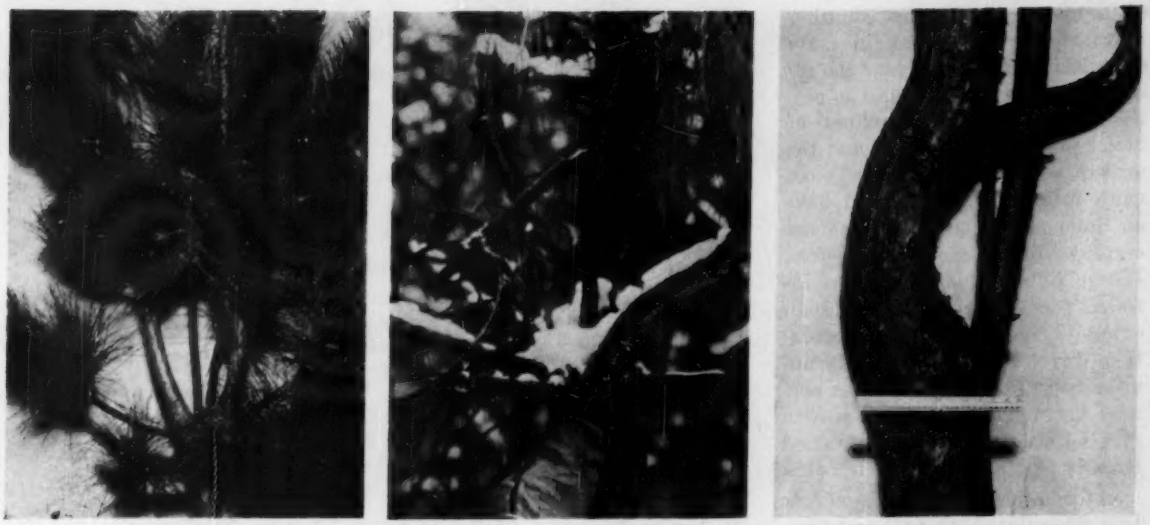

FIG. 4.—The bushing of terminals is a result of the production of adventitious buds when the terminal bud cluster is destroyed. A lower lateral branch usually assumes dominance. *Left*: a 4-year-old bushtop (Wexford County, Mich.). *Middle*: a 15-year-old bushtop (Washtenaw County, Mich.). *Right*: a 27-year-old bushtop (Rose Pond, near New Haven, Conn.).

merman pine moth often destroys the shoots by tunneling through the pith of the branches. Other insects which bore in the buds and pith are the Nantucket and pitch pine tip moths (*Rhyacionia frustrana* [Comst.] and *R. rigidana* [Fernald]). According to Miller and Neiswander (*15*), these two insects are more often met with south of the natural range of red pine. Although the native Dioryctria and Rhyacionia species kill the shoots, adventitious buds on affected trees seldom develop. There are very few cases of pruning, bushy tops, or posthorns. In addition attacks do not persist year after year as is usually the case with the European pine shoot moth. According to Martin (*12*) the pine bud moth, *Exoteleia dodecella* L., has recently caused damage in Canada similar to that of the shoot moth. Damage to red pine by the pine bud moth, however, usually occurs near heavy infestations of the preferred hosts—Scotch and Mugho pine. Also, the majority of attacks are limited to the lateral buds.

Infrequently, damage to the main stem or the lateral shoots of red pine is caused by porcupines, rabbits, red squirrels, and the pine and evening grosbeaks, but the damage is usually localized. The probability of confusing it with shoot moth damage is slight, as the shoot moth does not remove the bark or clip off the buds and shoots .

The only disease reported to kill the current season's shoot growth is caused by *Diplodia pinea* (Desm.). Although recent damage by this fungus may resemble shoot moth attack from a distance, close observation reveals the presence of mycelia and fruiting bodies. Older infections may be identified by sectioning. The disease, according to Waterman (*19*), stunts the growth of trees and may eventually kill young trees. The fungus *Dematium pullulans* de Barry has been found by Jump (*8*) to be associated with the forking of red pine in New York.

Red pine shoots can be damaged by various weather factors including hail, summer frost, and snow. Hail damage, according to Benjamin (*1*), is distributed evenly throughout a given area and bark lesions are restricted to the windward side. Often summer frost will quickly kill the foliage covered by the cold layer of air, according to Pomerleau and Ray (*17*). Extensive killing usually occurs in terrain depressions. Buds do not exhibit shoot moth damage unless the stand was infested prior to death. Carvell (*2*) believes that red pine forking is associated with early summer droughts followed by late summer rains, and Littlefield (*9*) thinks it may be correlated with early summer droughts and low site quality. Forking has also been reported in Wisconsin by McCabe and Labisky (*13*).

Heavy wet snows in young plantations often tear out some of the lateral branches or bend the entire stem. Guilkey (*6*) observed that permanent damage from bending occurred only when it extends down through the upper half of the crown. Branch breakage usually occurs below the top two whorls, and the branch is either broken or torn from the main stem. In both cases a dead branch is usually present. This does not occur in shoot moth pruning.

Discussion and Summary

A technique has been developed for dating the initial year of attack by the European pine shoot

moth upon red pine by counting internodes or the annual rings. By establishing the initial year the insect entered a plantation, it is possible to determine the extent of insect population buildup, and the growth of the trees under shoot moth infestation. This could have an influence upon decisions concerning direct control measures. Where a plantation has been infested for a long time without an excessive buildup of the population, direct control is certainly unnecessary. The technique also permits the comparison of the growth of plantations infested for varied lengths of time on different sites.

Information is also given on how to differentiate both past and present shoot moth injuries from similar injuries caused by other agents.

From a timber management viewpoint, the method makes it possible to identify and quantify losses in volume and quality resulting from shoot moth attack. A knowledge of the appearance of current or recent damage and of its long-term consequences is of value in timber stand improvement work.

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Cover

The fir root bark beetle (*Pseudohylesinus granulatus* Lec. with its cousin, the silver fir beetle, were not regarded as serious tree killers until during the period 1947-1955 they, in combination with other factors, killed 525 million board feet of mature Pacific silver fir in northern Washington. The outbreak demonstrated that sometimes forest pests regarded as unimportant may suddenly create problems of major concern to the forest manager.

Slash Helps Protect Seedlings From Deer Browsing

Ted J. Grisez

FORESTERS and landowners in the northern and eastern states are vitally concerned with the destructive browsing of forest regeneration by large numbers of white-tailed deer (*Odocoileus virginianus*). Attempts to prevent overpopulations of deer have been made through legislative and administrative measures with varying success, but more direct methods of reducing or eliminating browsing damage are also being sought.

Many foresters concerned with the deer problem have noticed that hardwood slash often seems to protect some seedlings enough so they can grow up out of reach of deer, whereas outside the slash, well-developed seedlings may be scarce or absent. In 1923 Pearson (*6*) noted that "brush tends to discourage grazing" (of domestic livestock). Clepper (*2*) observed in 1936 that loppings had been used successfully to protect planted seedlings from deer in Pennsylvania. Little and Somes (*5*) found that pitch pine reproduction in the slash of a cutover area in southern New Jersey suffered less damage from deer browsing than reproduction in slash-free spots.

On the basis of observations such as these, the Pennsylvania Department of Forests and Waters has discontinued its requirement for lopping of tops in state forest timber sales, except along certain roads.

To obtain more precise information as to whether or not slash protects seedlings from deer browsing—and if it does, to what extent—the Northeastern Forest Experiment Station made a study in Wayne County, Pa. The study was designed to: (1) compare the abundance and height of seedlings within and outside slash piles, and (2) compare the frequency of browsing within and outside slash piles.

Methods

A survey of reproduction was made in a 35-acre black cherry-beech-maple stand on the Pocono Experimental Forest near Gouldsboro, Pa., in April and May 1957. The stand had been cut to an 11-inch diameter limit 5 years before, when it was 55 years old. The residual stand had 164 trees, 1,129 cubic feet, and 62 square feet of basal area per acre in trees 5.0 inches d.b.h. and up. At the time of the survey, 26 percent of the study area was covered with slash.

FIG. 1.—Slash pile with reproduction growing up through it. Here there are four black cherry seedlings, one yellow-poplar, and one pin cherry seedling over 5 feet tall, as well as briars and smaller seedlings.

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The survey involved examination of 238 circular milacre plots—half located randomly in slash piles and the other half in the intervening open spaces.

Reproduction of all trees over 1 foot tall was tallied by species, height class, and degree of deer browsing on the previous season's growth. The height classes used were 1 to 3 feet, 3 to 5 feet, and 5 feet to 0.5 inches d.b.h. Seedlings under 1 foot in height were not tallied because browsing on them is not consistent; they may be covered by ferns in the summer and snow in the winter. Stems more than 5 feet tall are out of danger and free from deer browsing. Only four of the stems tallied were stump sprouts, although many of them, especially beech, may have been root suckers.

(No tally of seedlings was made at the time of logging, but it has been reported that there was a good crop of black cherry seedlings at that time.)

Browsing or lack of it was recorded in one of three categories: (1) unbrowsed, (2) only the top (leader) browsed, or (3) top and one or more branches browsed. However, for presentation here, the second and third categories were combined and are shown as "browsed." If side branches were browsed but not the top, the seedling was considered to be undamaged or "unbrowsed." This rarely happens except in seedlings more than 3 or 4 feet tall.

For each slash plot, the effective height of slash was recorded to the nearest half foot. Measurement was taken at the lowest height of the slash adjacent to or surrounding the tallest black cherry, white ash, yellow birch, or red or sugar maple reproduction. These are the merchantable species in this stand that ordinarily are browsed by deer. Beech is scarcely touched by deer in this region.

The reproduction tally plots plus 258 additional milacre plots (a total of 496 plots) were used to estimate the amount of deer use of the study area during the preceding dormant season. Estimation was by the pellet-group count method, as described by Bennett et al. (*1*), and adapted by Eberhardt and Van Etten (*3*). This count was made for possible use in relating this study to others dealing with deer browsing.

The pellet-count survey indicated that deer use of the study area during the preceding dormant season was at the rather high rate of one deer per 13 acres. Rabbit populations were very low.

Results

More seedlings of every species except beech were tallied on the slash plots than on the open plots (Table 1). On a per-acre basis, the stocking of all merchantable species other than beech was 5,814 stems per acre in slash as opposed to 2,218 in the open. The difference was very marked in black cherry over 3 feet tall: 1,034 stems per acre in slash, 84 per acre in the open.

Beech, which is not browsed appreciably, was more abundant in the open than in the slash. Differences were greatest in the 1- to 3-foot size class. This indicates that slash is somewhat detrimental to small beech seedlings and suckers. The absence of any marked differences within the taller classes of beech probably means that these stems were established before the stand was cut. It is reasonable to infer that, with no deer browsing, seedlings of the other species would also be more numerous in the open; i.e., slash probably deters the establishment of all species, but it deters the palatable ones less than browsing by deer does.

The number of stocked milacres was higher in slash than outside (Fig. 1). Differences in numbers stocked with each species and height class were analyzed by chi-square. Those with significant differences at the 5 percent level are shown in Table 2.

There were not enough stocked milacres in many species-height categories to give a good measure of significance; in others (beech 3+ feet and yellow birch 1+ feet), numbers were ample but differences were small. Black cherry, being the most abundantly represented of the palatable species, best shows the protective effects of slash in terms of both total numbers (Table 1) and stocked milacres.

Browsing damage on existing trees was definitely less in slash than in the open. Again, black cherry best shows the effect: in the 1- to 3-foot height class, 36 percent of the 425 seedlings in slash were browsed, as compared to 51 percent of the 186 in the open. This difference is highly significant.

Yellow birch, a palatable species that is well represented in the 1- to 3-foot class, was browsed about equally in slash and in the open. We cannot explain why slash in this instance failed to show a protective effect. Again, there were

TABLE 1.—NUMBERS OF STEMS TALLIED ON 119 MILACRE PLOTS IN SLASH AND 119 IN THE OPEN

Species	Height class, in feet											
	1 to 3				3 to 5				Over 5			
	In slash		In open		In slash		In open		In slash		In open	
	Not browsed	Browsed	Not browsed	Browsed	Not browsed	Browsed	Not browsed	Browsed	Not browsed	Browsed	Not browsed	Browsed
Black cherry	273	152	91	95	78	20	5	3	25	0	2	0
Yellow birch	76	35	46	17	6	2	0	0	0	0	0	0
Beech	105	0	223	0	76	1	92	0	87	0	75	0
Striped maple	9	14	1	11	4	10	4	5	22	0	7	0
Other species[1]	21	16	6	3	2	0	0	0	2	0	0	0

[1]Red maple, sugar maple, white ash, pin cherry, hornbeam, and serviceberry.

TABLE 2.—NUMBERS OF STOCKED MILACRE PLOTS FOR THE SPECIES AND HEIGHT CLASSES IN WHICH THE EFFECTS OF SLASH WERE STATISTICALLY SIGNIFICANT

Species	Height class[2]	Stocked plots	
		In slash	In open
	Feet	*No.*	*No.*
Black cherry	1+	69	45
Black cherry	3+	28	3
Black cherry	5+	10	1
Yellow birch	3+	6	0
Red maple	1+	11	2
Beech	1+	62	80
Striped maple	1+	29	16

[2]1+ inches all three height classes; 3+ includes two classes.

TABLE 3.—NUMBER OF PLOTS AND NUMBER OF SEEDLINGS 3+ FEET IN HEIGHT FOR ALL SPECIES EXCEPT BEECH, BY HEIGHT OF SLASH

Height of slash (feet)	Plots[1]	Stems per acre
	Number	*Number*
0.5	25	720
1.0	28	893
1.5	22	909
2.0	18	1,389
2.5	16	3,938
3.0	7	1,857
3.5	2	3,500

[1]The total is 118, since the height of slash on one plot was not recorded.

not enough seedlings in other species-height classes to permit valid measures of significance. However, it is obvious from the scarcity of taller stems of palatable species on the open plots (Table 1) that deer have largely prevented these species from growing out of the 1- to 3-foot class. Similar effects of deer browsing have been demonstrated on the Experimental Forest by fenced exclosures (*4*).

The effectiveness of slash piles increased with height up to 2.5 feet, and possibly higher (Table 3). Slash piles that were still 2.0 feet or more in height 5 years after cutting have given the seedlings excellent protection. The somewhat erratic figures for heights above 2.5 feet may be due to either the smaller number of samples or a growth-inhibiting effect of some of the largest and deepest slash piles.

Discussion and Summary

A survey of tree reproduction in relation to logging slash and deer was made 5 years after a heavy cutting in a black cherry-beech-maple stand. The study showed that substantially larger numbers of stems of the commonly browsed species were found in the slash piles than in the intervening openings, and that the incidence of browsing on existing stems was much less in the slash. The obvious conclusion is that slash exerts a definite protective effect.

It follows that, in areas where deer browsing limits reproduction, hardwood slash should be looked upon as a blessing, and not just as a fire hazard. Close utilization of tops for products such as fuelwood would reduce the volume of slash and the protection it affords. In respect to the fire hazard, there is little reason to lop or burn slash in most eastern hardwood regions, particularly in the northern hardwood type. But this study shows that in regions where deer are abundant, there is a good reason not to reduce the slash.

There are some possibilities for deliberately using slash to protect seedlings: trees might be felled into openings where reproduction is desired in such a way that the tops are in groups of 2 or 3, but not on top of each other; or, slash might be piled over wild seedlings as Clepper (*2*) suggested for planted seedlings.

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Nutria and Swamp Rabbits Damage Baldcypress Plantings

Robert M. Blair and Murphy J. Langlinais

NUTRIA and swamp rabbits have become serious deterrents to the establishment of baldcypress plantations in Louisiana—in some areas to the extent that planting has had to be suspended.

The seriousness of the problem was first realized in 1956, during an inspection of Soil Conservation Service-sponsored plantings in the vicinity of New Iberia. Where plantations had been established on nonflooded sites about 75 percent of the seedlings had been clipped at varying heights above the ground. On flooded sites, more than 90 percent of the seedlings were missing. The absence of seedlings was attributed to natural mortality. The clipping damage appeared due to swamp rabbits (*Sylvilagus aquaticus*).

To gain further information, we installed a study in a cutover swamp near Cypremort, La., where commercial cypress plantings in 1953 and 1954 had failed completely. Baldcypress seedlings (1-0 stock) averaging 26 inches in height and with rootcollar diameters of ⅛ to ½ inches were planted during January, 1957. The site had a jungle-like growth of vines, shrubs, and hardwoods. Some seedlings were planted where water was as much as 10 inches deep, others in saturated but nonflooded soil.

Damage of two distinct types soon became evident. Some seedlings were pulled out of the ground —on these the bark was eaten from the taproots. Others were clipped at varying heights.

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Uprooting was by far the most serious and widespread type of depredation. By May, 90 percent of the 2,100 test seedlings had been destroyed in this manner. Seedlings on flooded sites were pulled first, but as they became scarce uprooting extended onto nonflooded sites for 15 to 20 feet.

Clipping was largely confined to nonflooded trees. While most clipped seedlings were severed by a smooth, angled cut, a few were roughly cut.

Some of the seedlings had been treated before planting with either 4 percent nicotine sulphate, 6 percent nicotine, or 8 percent tetramethylthiuramdisulfide. None of these three candidate repellents prevented pulling losses and too few seedlings remained to determine whether the chemicals would reduce clipping damage.

Though nutria (*Myocastor coypus*, sometimes called coypu) were known to inhabit the area, they had not hitherto been suspected of cypress depredations. However, the pattern of damage, together with direct animal signs, strongly suggested that these semiaquatic rodents (Fig. 1), and not swamp rabbits, were responsible for pulling the seedlings and eating the bark from the roots.

To make possible direct observations, a 19×81-foot enclosure was constructed in the same swamp during February, 1958. Half of the pen encompassed a site flooded to a depth of about 14 inches, the other half was nonflooded. All shrubs, vines, and palmettos were cleared off and 1-0 baldcypress seedlings were planted. In March, two adult nutria were placed in the pen.

In 5 days of confinement the animals pulled 59 percent of the 300 seedlings on the flooded site. On the nonflooded part only 13 per-

FIG. 1.—The nutria is a large, brown, muskrat-like animal with a round, sparsely haired tail. Adult males weigh 20 to 25 pounds, females a little less. The body averages 24 inches in length, the tail 12 to 16 inches. The forepaws resemble those of a raccoon and are used to manipulate food. The hind feet are webbed.

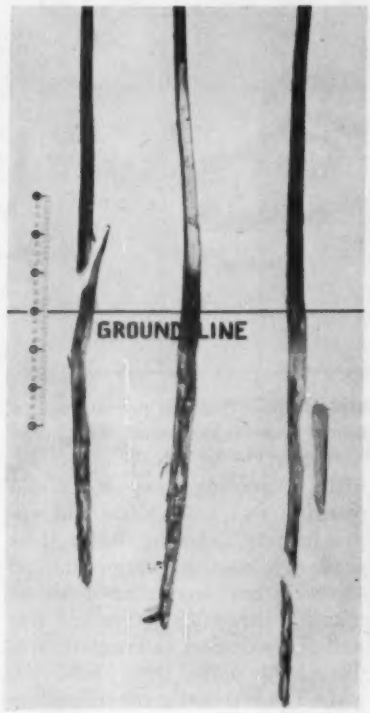

FIG. 2.—These are 1-0 cypress seedlings that were pulled by nutria soon after planting. The succulent bark was eaten from the carrot-like taproots. Uprooted seedlings are often severed near the root-collar and the taproots clipped into segments. In addition, large pieces are sometimes bitten indiscriminately from the stems and taproots.

FIG. 3.—*Left:* Swamp rabbits clip baldcypress stems and branches cleanly at a 45-degree angle. *Right:* The nutria make a rough-surfaced cut at an angle of 30 to 45 degrees with the stem. Sometimes the stems are partially severed and then broken over.

cent of the 300 trees were pulled, mostly adjacent to the water. This was an average daily destruction of 22 seedlings per animal.

Some of the seedlings had been treated with 10 percent cupric carbonate or with 10 percent ZAC (zinc dimethyl-dithiocarbamate cyclohexylamine complex) with Dow Latex 512-R as the sticker. Neither repellent reduced losses.

After pulling seedlings, nutria ate the succulent bark from the taproots and consumed the small roots entirely. The above-ground portions were not eaten. Generally, the animals clipped the stems of uprooted seedlings near the root-collar, apparently to make it easier for them to handle the root systems. Often the taproots were severed into short segments (Fig. 2).

A few seedlings were clipped at varying heights above the ground and some had large pieces bitten from the stems. The angle of clipping ranged from about 30 to 45 degrees. The cut surfaces were generally very rough, and often the stems were only partially clipped and then broken over. This is in contrast to the smooth 45-degree cut characteristic of rabbit browsing (Fig. 3).

Nutria preferred to feed in shallow water and would carry seedlings from the nonflooded site back to the flooded area before eating the roots. Because of this preference, the water was strewn with sections of debarked roots and seedling tops.

Our observations of the penned animals appear to confirm that nutria were responsible for the failure of plantings on flooded sites near New Iberia. Since their introduction from Argentina in the late 1930's, these animals have spread to lowlands in Mississippi and east Texas and at least as far north as the Red River in Louisiana. Hence, they may give trouble elsewhere.

Swamp rabbits were—as originally surmised—the chief cause of damage to the nonflooded seedlings at New Iberia. The 1957 study at Cypremort and subsequent observations in north Louisiana (beyond the range of nutria) indicate that rabbits characteristically confine their depredations to nonflooded areas and attack only aboveground portions of seedlings. The tender parts of clipped branches and stems are usually consumed for food, though some seedlings are maliciously cut and left uneaten. While rabbit damage is mitigated somewhat by the fact that seedlings generally resprout and continue to grow, the short sprouts may be covered and killed by shallow floods that the taller original stems would have survived.

Chiefly because of the extent and severity of rabbit and nutria depredations in the coastal areas, the Soil Conservation Service has recommended that its cooperators suspend planting of baldcypress until control measures can be formulated.

Exposure and Planting Depth Effects On Loblolly Pine Planting Stock On Poorly Drained Sites[1]

George L. Switzer

MINIMUM PERIODS of root exposure and nursery-depth placement of seedlings in the field have repeatedly been emphasized as important in initial success in planting. However the literature contains reports which indicate that some deviations from these classical standards can be tolerated. Slocum (*2*) and Slocum and Maki (*3, 4*) have indicated that loblolly pine planting stock is able to withstand considerable variation in both respects without significant depressing effects on its survival and growth. Other studies reported by Cummings (*1*) and Wakely (*5*) also indicate that varying periods of root exposure can be tolerated by shortleaf, longleaf, and slash pines. This report contains the results of experiments with loblolly pine on the effect of root exposure and depth of planting on two poorly drained sites.

Materials and Methods

Loblolly pine planting stock (1-0) from a local seed source was lifted from one seedbed in the Mississippi State University School of Forestry nursery, immediately placed in tubs containing enough water to cover the root systems, and transported to the planting sites on the Northeast Mississippi Experimental Forest. The seedlings were then graded (with roots still submerged) into lots of uniform size, subjected to exposure if necessary, and then planted.

A randomized complete block design containing five treatments and replicated three times was used. The treatments employed were: (1) correct planting depth with no additional exposure, (2) correct planting depth with five minutes additional exposure, (3) correct planting depth with ten minutes additional exposure, (4) one-half of stem buried with no additional exposure, and (5) stem buried to terminal with no additional exposure. Each treatment was composed of 25 seedlings. This design and replication were installed on two old-field sites, one having a poorly drained alluvial clay soil and the other a poorly drained silt soil. The two sites were predominantly covered with broomsedge and were within one-fourth mile of each other. Planting was done by hand with bars in the early afternoon of a bright sunny day in late February, 1958, having a temperature of 64°F, relative humidity of 56 percent and a 3-mile per hour wind from the northwest. The entire operation, lifting, grading, exposure, and planting was accomplished in approximately 2 hours. Rainfall at a nearby weather station totaled 41.08 inches from the time of planting through October and was well distributed. Temperatures during this period were about normal. These climatic conditions are considered quite favorable for the establishment of planted seedlings. At the completion of the first field growing season the installations were inventoried for survival and growth. An exception to this is that heights were not measured on the silt site since recent grazing damage had occurred there.

Survival.—The survival of the seedlings shows a marked response to the treatments employed on both sites as well as some marked differences between sites (Table 1).

The effect of exposure, although slightly greater on the silt, shows a consistent trend for both sites (Fig. 1). These results differ from

TABLE 1.—THE AVERAGE SURVIVAL AT THE COMPLETION OF THE FIRST FIELD GROWING SEASON AS INFLUENCED BY PLANT TREATMENT AND SITE CONDITION[2]

Treatment	Site Condition			
	Poorly drained clay		Poorly drained silt	
	Percent	*Arc Sin Trans.*	*Percent*	*Arc Sin Trans.*
Correct + 0 min. exposure	90.0	72.44	89.6	71.19
Correct + 5 min. exposure	77.4	61.62	71.7	57.86
Correct + 10 min. exposure	63.0	52.53	58.1	49.66
½ stem buried + 0 min. exposure	73.4	58.95	31.6	34.20
Buried to terminal + 0 min. exposure	21.2	27.42	0.4	1.15

[2]L.S.D.'s (arc sin transformation) to compare each site condition within each treatment or to compare each treatment within each site condition are 7.14 and 9.84 at the 0.05 and 0.01 levels respectively. The C. V. is 8.4 percent.

THE AUTHOR is associate professor, School of Forestry, Mississippi State University. He wishes to acknowledge the assistance of his Seeding and Planting class in the field installation of this study.

[1]Journal Contribution No. 789 of the Mississippi Agricultural Experiment Station.

From: Exposure and planting depth effects on loblolly pine by George L. Switzer.

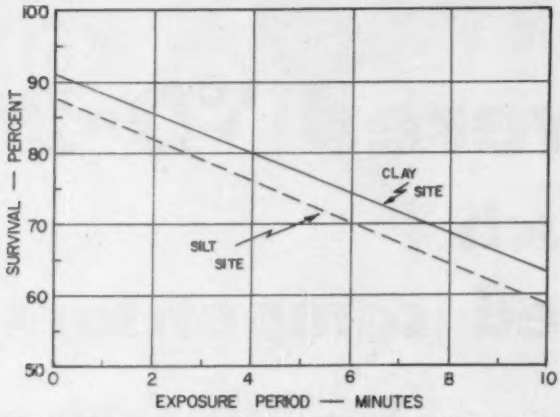

FIG. 1.—The average survival of loblolly pine at the completion of one field growing season as influenced by root exposure period and soil condition.

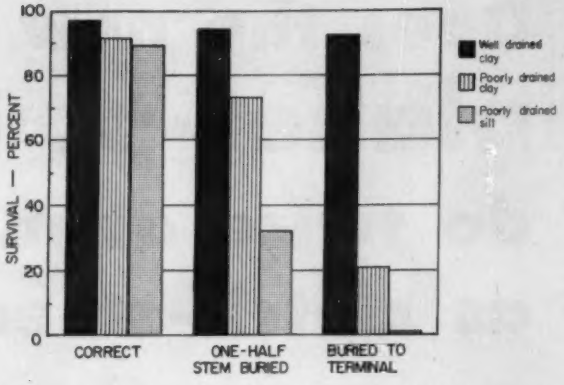

FIG. 2.—The average survival of loblolly pine at the completion of one field growing season as influenced by planting depth and soil condition. (Values for well drained clay from Slocum and Maki [3]).

TABLE 2.—THE AVERAGE TOTAL HEIGHT AT THE COMPLETION OF THE FIRST FIELD GROWING SEASON AS INFLUENCED BY PLANT TREATMENT ON THE POORLY DRAINED CLAY SITE[1]

Treatment	Total Height
	Feet
Correct + 0 min. exposure	1.37
Correct + 5 min. exposure	0.96
Correct + 10 min. exposure	1.30
½ Stem buried + 0 min. exposure	1.06
Buried to terminal + 0 min. exposure	0.63

[1]L.S.D.'s to compare treatments at the 0.05 and 0.01 levels are .318 and .463 respectively. The C.V. is 15.9 percent.

From: Exposure and planting depth effects on loblolly pine by George L. Switzer.

those reported elsewhere for this species. Slocum and Maki (*4*), from studies in North Carolina, stated that the safe exposure period for bare-rooted loblolly stock from heel-in beds or trenches is about 30 minutes. The disagreement of these data might be attributed to the differences attending the stock after lifting since these were directly planted, or to conditions at and during the lifting operations. In any event it appears that with bare-rooted stock the safest generalization to adhere to is the old one of keepng the exposure period at a minimum.

The effect of planting depth indicates that placement of the seedling at or near the original ground line should be adhered to on the sites considered in this study. It further indicates that correct placement is of greater importance on the silt than on the clay. This effect is perhaps due to differences in the aeration status of the two soils. Evidence also supporting this is that of Slocum and Maki (*3*) which was obtained on a well drained clay (Fig. 2). These results serve as verification of their caution against using their findings with deep planting on wet sites.

Growth.—The total height of the seedlings also shows some interesting response to the treatments (Table 2). The results obtained from exposure indicate that the effect is the elimination of the less vigorous plants. Perhaps this has some application in the selection aspects of forest tree improvement.

The effect of planting depth on total height appears to be consistent with that of survival. The decided initial reduction in total height associated with deep planting has important implications with respect to the plant's competitive position.

Summary

A study of the effect of root exposure and planting depth on the initial performance of bare-rooted loblolly pine planting stock on two poorly drained sites in Northeast Mississippi indicates that for these conditions it is important to keep root exposure at a minimum and to plant the seedlings at or only slightly below the original ground line.

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Notes and Observations

Nomenclature at the Montreal International Botanical Congress

No changes in the rules toward stabilization of scientific names of important economic plants were made by the Nomenclature Section of the Ninth International Botanical Congress at Montreal, Canada, August 16 to 19, 1959.

The Nomenclature Section, with more than 200 plant taxonomists from many countries enrolled, met at McGill University on August 16 to 19. I attended as the official delegate of the United States Forest Service Herbarium, Washington, D. C. The main congress during August 19 to 29 had a registration of about 2,500 plant scientists including many research foresters.

The Nomenclature Section devoted four days to considering about 300 proposals for amending the International Code of Botanical Nomenclature (1956) and which had been submitted since the Eighth International Botanical Congress at Paris in 1954. These proposals, made at least a year in advance, had been published in *Taxon*, the official news bulletin of the International Association for Plant Taxonomy, and again in the Synopsis of Proposals by J. Lanjouw (*Regnum Vegetabile* v. 14, 84 p. 1959). A preliminary mail vote was taken by the individual members of the International Association for Plant Taxonomy early in 1959 (*Taxon* 8:133-138. 1959).

Most proposals were minor, some involving only a few words or clarification of the text and examples, and were referred to the Editorial Committee. Others concerned special groups of plants, such as fungi, algae, fossil plants, and hybrids and were considered first by the respective committees. Many were automatically rejected after having been defeated by a majority of 80 percent or more in the mail ballot. The result will be a new edition of the Code incorporating the editorial and other minor changes adopted.

Stabilization of botanical nomenclature was the most important subject considered by the Nomenclature Section at Montreal (J. Lanjouw, Synopsis of Proposals, p. 5). At the Paris Congress in 1954, two proposals toward stabilization were defeated by small margins, but a resolution "that something should be done" to solve the present problems of nomenclatural instability was carried by a considerable majority. A Special Committee on Stabilization was selected to report at Montreal.

J. S. L. Gilmour, director, University Botanic Garden, Cambridge, England, and chairman of this committee, reported (*Taxon* 8:19-23. 1959) that a majority of the committee favored some modification of the Code toward this end. At Montreal he stressed the vital importance of taking some step and for cooperation with other users of plant names.

After limited discussion, a resolution proposed on the floor by Albert C. Smith, director, Natural History Museum, U. S. National Museum, Washington, D. C., was passed, as follows:

"The Section of Nomenclature believes that meticulous monographic and revisional studies of groups of plants, utilizing the principle of priority and its modifications as outlined in the 1956 edition of the Code, offer the best means of achieving future stabilization of specific names."

The vote was 278 to 100, by ballot, each person present having 1 personal vote and botanical institutes with herbaria having 1 to 7 votes according to the size of the staff. No vote was taken on the individual proposals about stabilization, though one for rejection of specific names (*nomina specifica rejicienda*) had received 91 personal votes for and 112 against in the preliminary mail vote, slightly less than a majority.

Then the following resolution drafted by a committee of three headed by J. Lanjouw, rapporteur general, was adopted:

The Nomenclature Section of the IXth International Botanical Congress is aware of the inconveniences for a large number of users of plant names caused by changes in the nomenclature of a number of species which are important economic plants, plants often used as text-book examples and plants that have been the subject of important scientific work. This section is therefore willing to cooperate with all those interested in bringing about stabilisation of these plant names. In order that the section may ascertain the number and identity of the species involved all organisations and all persons are invited to send to the General Committee lists of plant names for which stabilisation seems important whether or not these names are now threatened. Each name appearing on these lists must be accompanied by a statement of the general importance of the species. The Committee will study those lists and report to the next International Botanical Congress, and will set up an organisation for

this purpose. The hope is expressed that all those concerned will give scientific and financial support for this important and difficult task.

The secretary of the General Committee, to whom lists of important economic plants should be sent, is Dr. F. A. Stafleu, International Bureau for Plant Taxonomy and Nomenclature, 106 Lange Nieuwstraat, Utrecht, Netherlands.

The next International Botanical Congress will be held in 1964 in Europe at a city to be selected later. I was appointed on the Committee for Hybrids and shall be pleased to work with foresters and forest geneticists on problems of naming or designating hybrids.

Thus, stabilization of scientific names will be considered again at the next congress. A sizable minority of plant taxonomists and numerous other plant scientists want constructive measures toward stabilization.

Though monographic and revisional studies contribute toward stabilization of names, they often cause changes in nomenclature, such as by reexamination of type specimens. Also, these studies are limited in scope, often to a single genus, and are not available for many groups containing important economic plants.

The invitation by the Nomenclature Section to all organizations and persons to send lists of plant names for which stabilization seems important, whether or not these names are now threatened, should be accepted by plant scientists as a positive step, and those interested should cooperate. Many taxonomists fear that the list of names would become unduly large and would require much time in checking. However, past experience suggests the contrary. The response to a similar request by the Special Committee on Stabilization (Gilmour, *Taxon* 3:243-244. 1954) was negligible. Likewise, at the Sixth International Botanical Congress at Amsterdam in 1935, a motion was passed that an International Committee be appointed to draw up a list of names of economic plants according to the rules and that this list remain in use for a period of ten years (T. A. Sprague in Sirks, M. J. Zesde International Botanisch Congress Proc. 1:343. 1936). However, no list was published.

One effect of the resolution passed at Montreal may be to discourage or retard name changes of important economic plants. Workers in applied fields likely will prefer to retain the established names over any others that may be proposed by taxonomists, pending action at the next congress. However, there is a danger that prolonged delay might have the opposite effect of stabilization. Impatient workers in applied fields might set up their own lists of standard names of economic plants, perhaps for a particular country, while other names would be used by taxonomists and floras or in similar lists for a different country. Recent name changes present a problem, and reversal of names partly adopted seems doubtful, especially as action has been postponed again, and the new names will gradually become more familiar. It is hoped that all concerned will cooperate patiently in conformity with the International Code of Botanical Nomenclature.

For the native and naturalized trees of the United States, I have responded to the invitation by sending to the General Committee the Forest Service *Check List of Native and Naturalized Trees of the United States (Including Alaska)* (U. S. Dept. Agric., Agric. Handbook 41, 472 p. 1953; incidentally, still for sale by Superintendent of Documents, U. S. Government Printing Office, Washington 25, D. C., price $2.25). The Check List contains 865 species, including 78 naturalized, but only about one-fifth are important commercially. On pages 440-443, under "Commercial Names for Lumber," are listed 153 species of economic importance for lumber. Also, in the Check List the asterisk (*) designates 173 important forest tree species commercially useful for lumber or other products or noteworthy for other values.

Thus, the names of these 173 species of important economic plants have been submitted to the General Committee as names for which stabilization would be desirable, though of less importance in some than others.

Also, out of the 173 species, I have submitted to the General Committee the following names of 7 native tree species of economic importance to the United States for which stabilization seems important because other names (in parenthesis) also are in use.

Acer saccharum Marsh. (*A. saccharophorum* K. Koch)

Betula lutea Michx. f. (*B. alleghaniensis* Britton)

Nyssa aquatica L. (*N. uniflora* Wangenh.)

Pinus palustris Mill. (*P. australis* Michx. f.)

Pseudotsuga taxifolia (Poir.) Britton (*P. menziesii* [Mirb.] Franco)

Quercus rubra L. (*Q. borealis* Michx. f.)

Sequoia gigantea (Lindl.) Decne. (*S. wellingtonia* Seem.)

All these 7 widely used names except *Betula lutea* and *Pseudotsuga taxifolia* were adopted in the 1953 Check List.

As in the past, the United States Forest Service with its dendrologist and plant taxonomists will continue to cooperate with plant taxonomists and foresters toward uniform usage of scientific names. The Forest Service Check Lists have followed monographic and revisional studies. Names in the 1953 edition were carefully verified and checked with the International Code of Botanical Nomenclature. Published at long intervals of more than twenty-five years, the Forest Service Check Lists have served to stabilize scientific names of trees for foresters, making any necessary changes in nomenclature together at one time. At present no revision of the nomenclature is needed.

ELBERT L. LITTLE, JR.
Dendrologist,
U. S. Forest Service,
Washington, D. C.

Timesavers for Installing Dendrometer Bands

The authors have devised two timesaving methods for making and installing tree dendrometer bands.

The first method requires essentially the equipment described by Liming,[1] but field time is saved by making the bands in the office during off-seasons, and by omitting the scribing of a vernier scale on the band. The procedure involves preparing a supply of bands of stock lengths, with sleeve and primary scale. Lengths of 26, 32, 39, and 46 inches will serve roughly for trees smaller than 6.5, 8.5, 10.5, and 12.5 inches d.b.h. respectively. Field work is then restricted to (1) trimming the band to specific length, (2) making the cutout on the overlap, (3) attaching the spring, and (4) marking the zero point on the overlap when the band is positioned on a tree. The vernier is carried as a separate scale.

Figure 1 shows the equipment needed for an installation (except for a spring). The template has several features that differ from the model described by Liming. These include separate plates for the scale and scale-vernier, instead of one plate which provides for both. Each plate is attached to a common base which can be mounted on a board; the separate plates are drawn up with one wingnut each, rather than two. Two steel dowels are used to line up each plate; they also position the tape while it is being scribed. A dot code is provided to mark the one-, two-, and three-inch graduations, the dots being made by inserting a punch into holes and tapping lightly. Templates are available for direct reading of circumference in inches and tenths or in diameter equivalents.

As shown in Figure 2, only the zero point need be marked on the band-overlap. When readings to 0.01 inch are needed, a vernier scribed on a separate piece of tape may be lined up with the zero point of the band.

An alternative method is to use a dendrometer band scale-stamp, devised by the senior author in cooperation with the Arkansas Die-casting Company, Harrison, Ark.

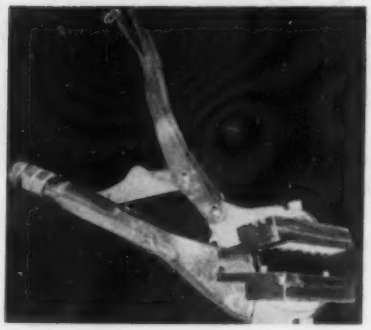

FIG. 3.—With the dendrometer scale-stamp, one squeeze of the hand impresses the 3-inch scale and dot code on the aluminum band.

The stamp (Fig. 3) is available on special order. It is graduated only in inches and tenths, not in d.b.h. equivalents. This instrument is more expensive than a template for hand-scribing but will save its cost when numerous bands are required. Metal strips with a hand-scribed vernier are supplied with the stamp, or a vernier template can be obtained.

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Southern Forest Experiment Station, Forest Service, U. S. Department of Agriculture, Harrison, Ark.

[1]Liming, F. G. Homemade dendrometers. Jour. Forestry 55:575-577. Illus. 1957.

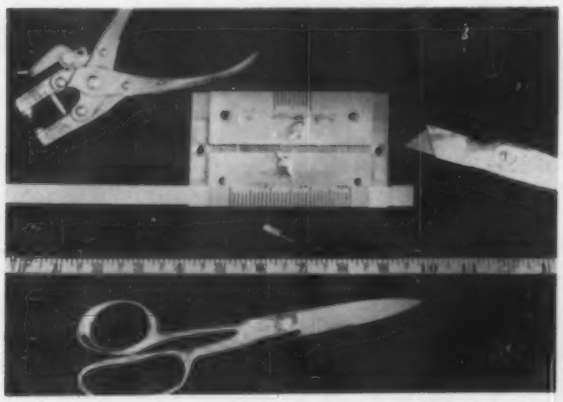

FIG. 1.—These are the tools needed for hand-scribing dendrometer bands. The template incorporates several unique features. The Case scissors has serrated blades and leverage for easy cutting of aluminum bands.

Right

FIG. 2.—The zero point is scribed on the overlap and bands may then be read directly to the nearest tenth-inch. For readings to hundredths of an inch, a portable vernier strip may be laid on the zero point of the band.

Aerial Foliage Sprays Fail to Eradicate Scrub Oaks on Florida Sandhills

Establishment of pine plantations on the sandhills of northwest Florida necessitates almost complete removal of the brush and grass that compete for soil moisture on these dry sites.[1]

To test the effectiveness of chemical growth regulators in eradicating this vegetation, the Marianna Research Center of the Southern Forest Experiment Station has screened a large number of formulations and combinations of chemicals. In all cases the competitive plants were inadequately controlled, but a few phytocides have shown promise.

Preliminary screening was by various methods of ground application, but in June of 1956 and 1957 the phytocides were applied as sprays from a helicopter. The results reported here are chiefly from the 1957 test, which included the best of the chemicals applied the year before, plus some not previously tried.

Thirty-five treatments were installed, with only the most promising ones replicated, to give a total of 57 two-acre plots. Chemicals and formulations were:

Growth regulator	Form in which used
2,4-D	Iso-octyl ester
2,4,5-T	Iso-octyl ester
2,4,5-T	Propylene glycol butyl ether ester[2]
2,4,5-T	Unknown[3]
2-(2,4,5-TP)	Propylene glycol butyl ether ester
2-(2,4,5-TP)	ACP-L-650[4]
2-(2,4,5-TP)	ACP-L-689
2-(2,4-DP)	ACP-L-685
2-(2,4-DP)	ACP-L-688
4-(2,4-DB)	Butyrac 118[4]
2,3,6-TBA	ACP-M-103
2,3,6-TBA	Sodium salt[5]

Rates of application ranged between 0.5 and 3.0 pounds of acid equivalent per acre in concentrations varying from 16.67 pounds of acid per hundred gallons (ahg) to 100 pounds ahg. A total volume of 3 gallons of diluted mixture per acre was maintained for most chemicals and concentrations, but 2 of the 57 treatments required a volume of 5 gallons per acre. The helicopter, a Bell model 47 with front-mounted spray boom, flew at an altitude of 50 to 80 feet and at an approximate speed of 40 miles per hour.

In most formulations water was the carrier, but diesel oil, Solvosol 35, and a non-phytotoxic horticultural oil were included in some treatments as aqueous suspensions and in some instances at full strength. The decision to rely on water was based on results from the 1956 tests, in which many oak leaves exhibited a partial but rapid spotty necrosis when diesel oil constituted part of the diluent. It is probable that translocation of phytocides from these necrotic areas was inhibited, resulting in poorer kill.

As a check on spray distribution from the helicopter, a red oil-soluble dye had been added to the formulations during the 1956 test. White cards placed at 5-foot intervals across the plots perpendicular to the flight lines showed spray coverage to be satisfactory and even except for 10 to 15 feet along the edges of the treated areas. In 1957, an untreated border strip of 50 feet was maintained between each 2-acre plot, and data were taken only on vegetation at least 30 feet inside the boundaries of treated areas on an 8-foot swath running diagonally across the plots. Relative abundance of the species tallied is shown in Table 1.

Effectiveness of the phytocides was measured two growing seasons after application. As Table 2 indicates, the best control of turkey oak and saw-palmetto, as well as the best over-all control, was achieved with the propylene glycol butyl ether ester of 2-(2,4,5-TP) at three pounds acid equivalent per acre in a non-phytotoxic oil-water carrier. The same phytocide, but

TABLE 1.—CHIEF WEED SPECIES ON STUDY AREAS

Species	Stems per acre	Proportion of total
Turkey oak (*Quercus laevis* Walt.)	1,855	47.0
Sand post oak (*Q. stellata* var. *margaretta* (Ashe) Sarg.)	702	17.8
Bluejack oak (*Q. incana* Bartr.)	618	15.6
Saw-palmetto (*Serenoa repens* (Bartr.) Small)	515	13.0
Persimmon (*Diospyros virginiana* L.)	229	5.8
Others	32	.8
	3,951	100.0

TABLE 2.—THE TWO PHYTOCIDES MOST EFFECTIVE AGAINST SANDHILLS SCRUB TREES

Phytocide	Acid per acre	Concentration and carrier	Percent kill by species[1]				
			All	Turkey oak	Sand post oak	Blue-jack oak	Saw-palmetto
	Pounds		*Percent*				
2-(2,4,5-TP) propylene glycol butyl ether ester	3	100 lbs. ahg in non-phytotoxic oil and water	34	57	19	13	42
2-(2,4,5-TP) propylene glycol butyl ether ester	3	100 lbs. ahg in diesel oil and water	25	17	60	23	0
2,4,5-T, iso-octyl ester	3	100 lbs. ahg in water	25	21	32	31	18

[1]Trees were not classified as killed unless tops were dead and basal sprouts were lacking.

[1]Woods, Frank W. Some effects of site preparation on soil moisture in sandhills of west Florida. Soil Sci. 85:148-155. 1958.

[2]Experimental material of Dow Chemical Company containing a special emulsifying agent for mixing with oil.

[3]Experimental material of Stull's Chemicals, Incorporated.

[4]Experimental material of Amchem Products, Incorporated (formerly the American Chemical Paint Company).

[5]Experimental material of E. I. duPont de Nemours & Company.

in a diluent of diesel oil and water, produced the greatest mortality in sand post oak. Bluejack oak was controlled best by the iso-octyl ester of 2,4,5-T in water at three pounds acid equivalent per acre.

These performances were relative. Not even the best phytocide controlled the scrub trees to the extent required for successful pine establishment and growth. Furthermore, grasses were little affected by any phytocide application, and grass is often more detrimental to pine survival on these dry sites than are the scrub trees. Use of phytocides for sandhills site preparation therefore cannot be recommended at this time.

ERWIN B. DUMBROFF
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Bushel Baskets Make Low Cost Seed and Litter Traps

A dual-purpose trap was developed by the Station staff in Missouri for collecting seed and litter in field studies. These traps, made from bushel baskets, are cheap, easy to install and maintain, and sturdy enough to resist possible livestock damage.

Materials

Materials needed for each trap are:

Bushel basket (wooden or woven bottom, depending on type of support used)

Square yard of unbleached muslin

Wire staples, 5/8-inches long

Circular piece of 1-inch mesh, 30 gauge chicken wire, 17 inches in diameter

2-foot treated post, 3-inch lag screw, and a 1½-inch flat washer, or 2 3-foot wooden stakes or cull barrel-stave blanks

All this costs less than a dollar.

Installation

The supports for the trap are usually installed first. Either of two methods of supporting the trap may be used. One way is to drive a 2-foot, creosoted post about 3 inches in diameter into the ground to about half its length. Then fasten the basket to the top of the post with a 3-inch lag screw (Fig. 1*A*). A 1½-inch flat washer prevents the head of the screw from drawing through the bottom of the basket. Wooden-bottom baskets are required for this method.

The other method is to drive two stakes or cull barrel-stave blanks about 3 inches wide and at least 3 feet long into the ground on opposite sides of the basket parallel to the basket sides. Then slip the basket handles over the ends of the stakes and push the basket down until it fits snugly between the stakes (Fig. *1B*). Both woven-bottom and wooden-bottom baskets are suitable for this method.

After the baskets are fastened to the supports, fit a square yard of muslin into the top of the basket so that the sag is about 4 inches above the bottom of the basket. Gather and staple the liner edge all the way around the basket rim on the outside (Fig. 2*A*).

Fit the circular piece of chicken wire into the top of the basket about 3 inches below the rim (Fig. 2*B*). This wire screen prevents pilfering of seed by rodents and birds. The 3-inch recess prevents the litter from blowing out of the basket. For litter collections only, the screen is not needed.

Discussion

The relative ease of installation is one of the definite advantages of this trap. Two men can install a trap in 3 to 5 minutes. Preparatory work of cutting the wire

FIG. 1.—The basket is fastened to one of two types of supports: *A*, a single-treated post, or *B*, two wooden stakes.

FIG. 2.—After fastening the basket to the supports, the liner is fitted into the basket and stapled to the outside of the basket rim (*A*) and the trap is completed by inserting the wire screen to prevent loss of seed to birds and rodents (*B*).

screen and the muslin involves an additional 2 to 4 minutes per trap.

The bushel basket seed-and-litter trap requires very little maintenance. Baskets kept in the field all year around for more than 5 years in the Missouri Ozarks are still serviceable. The muslin liner will last about 3 years before replacement is necessary. The basket and muslin liner might last longer if treated with one of the many preservative chemicals commercially available. To avoid or delay liner replacement, it may be practical to use fine-mesh, woven-plastic screening material. This costs more than muslin, but a few test traps with this lining material indicate that the greater cost may be justified because of longer service. The wire screen and the treated post will last for many years.

Traps of this type are being successfully used in collecting pine seed and litter and acorns and oak litter. Most pine seed, acorns, and pine litter sift through the wire screen; most hardwood litter stays on top. Seed and litter are easily collected by removing the wire screen, shaking the material to the bottom of the liner, scooping it out, and placing it in a suitable container.

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Cull or Defect?

Many of us are guilty at times of using loose terminology and not saying exactly what we mean. It is more commonly done in conversation, but sometimes it creeps into our writing. Two terms that are often incorrectly used interchangeably are *defect* and *cull*. They are defined in *Forestry Terminology*[1] as follows:

Defect: Any irregularity or imperfection in a tree, log, piece product, or lumber that reduces the volume of sound wood or lowers the durability, strength, or utility value.

Cull: A tree or log of merchantable size rendered unmerchantable because of poor form, limbyness, rot, or other defect.

Thus, by definition, cull results from a defect or an accumulation of defects that cause unmerchantability. However, trees, logs, piece products, and lumber containing defects are not cull material unless the defect is inadmissible, according to specifications, in the product.

It is practically impossible to find a tree without defects. Yet there are many trees having defects that do not preclude manufacture into the highest value products. In some cases, however, a single defect can limit merchantability in itself; e.g., shake in veneer logs, worm holes in stave bolts, and rot in tie bolts. Material containing these defects is cull for those products.

Furthermore, wood material may be cull for some products but acceptable for others. Thus, cull veneer logs may be acceptable sawlogs, cull structural timber logs may be acceptable for sawing into factory grade lumber, and cull factory grade sawlogs may be satisfactory for several bulk wood uses.

The term "defect" can be confusing if the user does not specify whether he is speaking of *scaling defect* or *grading defect*. The former is that for which a scaling deduction is made and thus affects the net volume of the product. Grading or quality defects (as well as the log dimensions) determine log grade and the acceptability of the tree or log for a specific use, but do not affect log scale.

To say a tree is defective is not

[1]Forestry Terminology. Society of American Foresters, Washington, D. C. 1958.

accurate unless the product for which it is defective is named. The term "cull sawtimber stand" should imply that the stand is of sawtimber size but not merchantable for sawtimber because of defect. However, such a stand may be merchantable for other products. There can be no such thing as a "cull tree" except when a tree has no present or foreseeable value for any commercial product.

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Converting Upland Hardwoods by Planting Pine in Scattered Clearcut Patches

A study was initiated in the Duke Forest in Durham County, N. C., to aid in determining the minimum area necessary for loblolly pine seedlings to survive and maintain satisfactory growth, in scattered patches throughout a white oak-black oak-red oak stand.[1] Patches of the type described here could form nuclei for pine regeneration for the replacement of slow-growing or poor quality hardwoods.

Hardwoods in the study area included hickory (*Carya* spp.), white oak (*Quercus alba* L.), southern red oak (*Quercus falcata* Michx.), black oak (*Quercus velutina* Lam.), black gum (*Nyssa sylvatica* Marsh.), red maple (*Acer rubrum* L.), yellow-poplar (*Liriodendron tulipfera* L.), and dogwood (*Cornus florida* L.). The area has very gently rolling topography with good surface drainage. The soils are sandy loams derived from Triassic sandstone with a soil site index for loblolly pine (*Pinus taeda* L.) ranging from 65 to 85 feet.

Circular patches were established with buffer zones. The patches were of three sizes: half-, quarter-, and eighth-acre, with radii of 83.3, 58.8, and 41.7 feet, respectively. All merchantable hardwoods were cut from the patches and the remaining trees over 3.5 inches d.b.h. were frilled and poisoned with a solution of two pounds of ammate per gallon of water. All other stems were cut and removed from the patches. The stumps of all cut trees, deemed likely to sprout, were treated with ammate.

Graded 1+0[2] loblolly pine seedlings were planted at 6-foot intervals in concentric circles, spaced six feet apart. One half-acre patch, two quarter-acre patches, and three eighth-acre patches were planted in the spring of 1952. Three additional eighth-acre patches were planted in the spring of 1954. The average number of circles and pine seedlings planted on the patches is shown in Table 1. The planted patches were cleaned as needed during the 1952-1958 period, all at least once and some twice.

In the autumn of 1958, the condition of the patches was variable, with the larger ones (half- and quarter-acre) showing a definite tendency to be in better condition. Briars, vines, and undesirable hardwood species occurred on all the plots. Their detrimental effects were negligible on the larger patches as the seedlings were able to develop and compete more successfully with the undesirable vegetation.

The height growth of the planted pines averaged at least two feet per year in the centers of all the patches. However, the favorable growth rate on the two smallest patches was restricted to an area within a radius of 14 to 20 feet of the patch centers. The effect of competition from trees and shrubs along the margins retarded height growth of pines in the outer three rows in all the patches, and the pines frequently leaned toward the patch centers. The average areas of reduced growth were 0.15, 0.14, and 0.09 acre, respectively for the half-, quarter-, and eighth-acre patches. Except for the outer three rows, good height growth occurred throughout the half-acre patch (Fig. 1).

Survival of seedlings and stocking in patches was generally good. However, poor stocking resulted where undesirable species gained dominance before the pine could develop, mainly on the eighth- and quarter-acre patches (Table 1).

To determine whether there was a tendency for better height growth on the north side of the patches because of the greater amount of direct light reaching the seedlings, trees were measured separately in

[1] Professor Kenneth L. Carvell, Division of Forestry, West Virginia University, assisted materially in the early years' work on the project while a part-time assistant in the Duke School of Forestry and offered helpful suggestions on the manuscript.

[2] Based on suggested usage; see Jour. Forestry 57:45. 1959.

TABLE 1.—SEEDLINGS PLANTED AND SURVIVAL BY SIZE OF PATCH

Patch size	Half-acre	Quarter-acre	Eighth-acre
Number of circles planted	12	9	6
Number of trees planted per patch	473	270	125
Number of trees planted per acre	946	1,080	1,000
Number of surviving trees per patch (1958)	454	189	109
Number of trees per acre (1958)	908	756	872
Percentage survival (1958)	96.0	70.0[1]	87.2

[1] The comparatively low survival in the quarter-acre patches is the result of two areas being inadequately stocked with pine, because they had been taken over by undesirable vegetation.

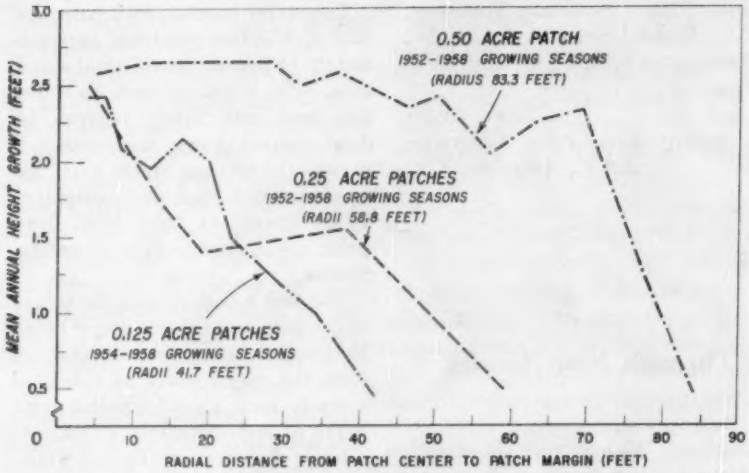

FIG. 1.—Mean annual height growth in relation to distance from patch centers to patch margins.

the four cardinal directions radially from the patch centers. No relationship was found between cardinal position and either survival or height growth.

This method of partial stand conversion may have application in the conversion of oak and oak-hickory stands to pine or in regenerating pine stands on a farm woodland scale. Such a practice could fit into time schedules of working landowners and could be useful in filling needs for part time work in off seasons. Areas or patches of a minimum size of one-half acre are recommended. Within circular half-acre or larger patches, the effects of a surrounding hardwood stand appear to be negligible in a 14-foot strip inside the perimeter of the patch. Except within this strip, both survival and height growth of the planted loblolly were good.

In clearing patches, immediate chemical treatment of cut stumps and remaining small undesirables is necessary. If hardwood invasion is rapid, it may be necessary to follow with a mechanical cleaning of undesirable species within two or three years after planting to release the pines.

This method would be more effective on poorer sites where pine seedlings can work up through the more open overstory of less aggressive hardwoods. Necessary cleanings would be considerably reduced because of the slower growth of hardwoods and the availability of better chemical formulations and methods of application. By applying previously established data on seed dispersal from a mature, fully stocked loblolly pine stand in the Duke Forest,[3] the minimum number of mechanically spaced patches necessary to obtain natural reproduction of pine on the area surrounding the planted patches was calculated. It was determined that a half-acre circular patch of mature pine could supply adequate seed for regeneration of 1.33 acres of surrounding land. This means that 5 to 6 such patches would be needed to supply seed for a 10-acre area. This method might appeal to owners who would prefer to obtain complete stand conversion over a longer period and at a lower initial cost than to clear cut and plant all of a stand area at one time.

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[3]Pomeroy, K. P., and C. F. Korstian. Further results on loblolly pine seed production and dispersal. Jour. Forestry 47:968-970. 1949.

An Introduction To The American Society of Photogrammetry

Photogrammetry is defined as the science of obtaining reliable measurements of objects from their photographic images. In terms of manpower and instrumentation, the principal uses of aerial photogrammetry have been in compiling topographic and planimetric maps. However, recent years have seen this expanding technology become an important tool of foresters, game managers, soil scientists, highway engineers, geologists, and others. Paralleling this advance has been the growth of the American Society of Photogrammetry. Founded in 1934, the Society now has 3,500 members in the United States and foreign countries. About 150 to 200 of these are professional foresters.

Unlike many other scientific organizations, the American Society of Photogrammetry is not comprised of members from one or two technical disciplines. Instead of viewing photogrammetry as a strict profession in itself, the society attempts to encourage interest among all professional groups. As a result, the only quality common to all its members is an engaging interest in terrestrial or aerial photography.

The diversified pattern of society interest is reflected in the format and coverage of the official journal, *Photogrammetric Engineering*, issued 5 times each year. Recent articles have run the gamut from "Precision Photogrammetry in Missile Testing," to "Measurement of Migrating Salmon by Paired Underwater Cameras." Articles on forestry applications of aerial photography also appear regularly. Each year the society holds a national technical meeting in Washington, D. C., in conjunction with the American Congress on Surveying and Mapping. Well-planned exhibits of photographic and photogrammetric equipment are among the principal attractions at these meetings.

Foresters are not only eligible

for membership in the Society—they are invited to become active participants. Society aims and functions do not conflict with those of other professional groups but serve rather as a complement to them. Interested persons may address the Secretary-Treasurer, 1515 Massachusetts Ave., N. W., Washington 5, D. C., for additional details.

GENE AVERY
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Translocation of Silvicides Through Root Grafts[1]

With the increasing use of silvicides, and the potential use of systemic insecticides, in forest management, a need for better understanding of the occurrence and function of natural root grafts has arisen. During a recent study of root grafting in eastern white pine (*Pinus strobus* L.) (*1*), a stand was observed which illustrates the need for basic research in this area.

On August 31, 1956, a 30-year old plantation of white pine on the Massabesic Experimental Forest in southern Maine was chemically thinned. A tablespoon of crystalline ammonium sulfamate (ammate) was placed in each of 1 or 2 ax-cuts approximately 2 feet high on trees marked for removal. Within 2 weeks poisoning symptoms were noted, and, ultimately, all treated trees and many untreated trees died. In July of 1958 the authors visited the stand to study the nature and extent of the damage.[2]

[1]This work was supported by National Science Foundation Grant 3222, and Atomic Energy Commission Contract at (30-1)-2037.

[2]The authors are grateful to T. W. McConkey, of the Northeastern Forest Experiment Station, for bringing the stand to their attention and facilitating its study.

The stand was sampled with five 32.5 × 32.5-foot quadrats, approximately 18 percent of the total stand area. The d.b.h. of each poisoned tree, and each living, injured, or dead untreated tree was recorded, as was the distance from each untreated tree to its nearest neighbor. Trees known to have been dead prior to the treatment were not recorded.

The soil was examined by means of two pits and several auger holes. Mechanical analyses of samples from the major horizons indicated a sandy loam topsoil grading, at a depth of approximately 3 feet, into a layer of gravel. Estimated drainage varied from excessive, atop a small knoll, to moderate, at the base of the 6 percent southeast facing slope. The stand was planted on a 6 × 6-foot spacing, with some interspersed volunteers, and the

FIG. 1.—Partially exposed root systems showing 6 grafts between the poisoned tree, on the left, and the untreated but dead tree, on the right.

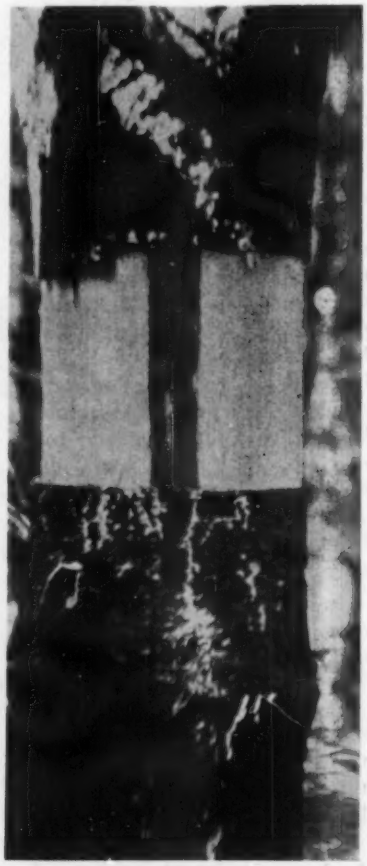

FIG. 2.—Brown streak in the outermost sapwood resulting from ammate poisoning.

average d.b.h. of living trees was 6.5 inches.

Of 151 trees found on the plots, 71 had been poisoned, and 80 had received no poison. Of the untreated trees, 33 were dead, 1 was injured, and 46 were apparently healthy. Thus, 2 years after poisoning, 43 percent of the untreated trees were dead or injured.

Excavation of several root systems indicated that death or injury had been caused by poison translocated through natural root grafts, so-called "backflash."

One dead untreated tree was found to be grafted to a poisoned tree through two grafts, each 1 inch in diameter, while a second was united with a poisoned tree by six grafts ranging from 1 to 2 inches in diameter (Fig. 1). Removal of a 6-inch strip of bark from the one injured untreated tree revealed a dark brown streak, typical of ammate poisoning, in the outermost ring of sapwood (Fig. 2). Resin flowed freely from the surrounding tissue, but not from the discolored streak, indicating that the epithelial cells of the resin ducts had been killed. Tracing the streak downward, it was found to move inward to deeper sapwood at a branch whorl about 3 feet above the ground. Below the whorl, the streak, visible only as a faint discoloration in the inner 9 rings of sapwood, was traced to a major root. A branch of this major root, 0.6 inch in diameter, was grafted to a large root of a poisoned tree 7.5 feet away. Although the branch root was dead, the newest wood of the main root was alive, suggesting that the ammate had moved through the deeper sapwood as it had in the lower trunk.

Other workers have reported backflash. Cook and Welch[3] report instances in New York in which plantations of red or white pine, thinned with sodium arsenite, showed losses up to 20 percent of the residual stand. In a 22-year old red pine plantation, thinned with Atlas "C," they observed backflash damage to 25 trees. Another report, made available by the Vermont Department of Forests and Parks,[4] indicates that 21 trees in a 0.5-acre stand of red pine, thinned with arsenite, were noticeably damaged by backflash.

In the light of the present report, thinning white pine stands with silvicides might be expected to result in serious backflash damage, particularly since intraspecific root grafting in this species is common.[5] In a general statement involving several species, however, Rushmore,[6] maintains that backflash damage is negligible. If Rushmore's observations have included white pine, it would appear that intraspecific root grafts in pine translocate poisons only under particular circumstances.

The obvious general areas in which further research seems warranted are: Specific responses to various types of silvicides, size of dose, and time and method of application. In addition, however, a study of internal and external environmental conditions governing transport through root grafts would seem prerequisite to the extensive selective use of silvicides in white pine management.

Summary

An instance is reported in which 43 percent of the untreated trees, in a 30-year old white pine plantation, were killed as a result of backflash following a thinning with ammonium sulfamate. Two other reports of similar occurrences with less serious results are cited. It is suggested that study of factors controlling translocation through root grafts seems prerequisite to efficient use of silvicides.

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[3] Cook, D. B., and D. S. Welch. Backflash damage to residual stands incident to chemi-peeling. Jour. Forestry 55:265-267. 1957.

[4] Personal communication.

[5] Bormann, F. H., and B. F. Graham, Jr. The occurrence of natural root grafting in eastern white pine, *Pinus strobus* L., and its ecological implications. Ecology 40:697-691. 1959.

[6] Rushmore, F. M. Sodium arsenite in spaced ax cuts: an effective stand-improvement technique. Jour. Forestry 56:195-200. 1958.

Points of View

Title Terminology in Forestry Positions

Foresters have long been concerned about inadequate public recognition of their profession. It seems to this observer that one method of gaining increased recognition would simply be for foresters to include their professional title, "forester," in their official title.

Foresters seem to have a tendency to refer to themselves as being just about everything but foresters. Titles such as forest manager, woodland conservationist, woodlands superintendent, silviculturist, forest ranger, forestry consultant, and dozens of others, appear constantly in newspapers, magazines, technical publications, television, and other publicity media. Is it any wonder that adequate public recognition of our profession is not forthcoming? The public is confused by this multiplicity of titles and does not understand that in most cases persons holding these titles are professional foresters.

I wonder how much better our profession would be recognized if all foresters used the word "forester" in their official titles. Professional foresters are performing a tremendous service to the public that is not being adequately recognized simply because the public has no way of knowing that foresters are responsible for this service. We are masquerading under too many titles.

A forester should do all he can to have the professional title of forester included in his official title. Modifying abjectives may be necessary and desirable. Such titles as state forester, district forester, industrial forester, watershed forester, and the like are excellent. They not only better define the exact function of the forester, but they help the public to better understand the wide scope of forestry programs.

The excellent work being carried on by foresters in the U. S. Forest Service is constantly in the public eye. It is unfortunate for the profession that the accomplishments of these men are not credited to foresters, but rather to "forest rangers." In other organizations, subprofessional and nonprofessional employees carry the ranger title and profit more from Forest Service publicity efforts than professional foresters in the same organization. Would it not be possible for the Forest Service, for example, to have a district forester rather than a district forest ranger in charge of a ranger station? This change would not even necessitate the removal of a single ranger station sign. The effect on nationwide public recognition of foresters and the practice of forestry would be favorable. I even expect that the registration and licensing of foresters would meet less opposition and proceed faster because the public would more fully understand our contribution to their welfare.

There is no intention here to single out the Forest Service on this matter. This is only done to point out the scope of the problem. It is recognized that the changing of a title cannot always be easily accomplished. Tradition and other factors may even preclude such a change.

Many other foresters, including myself, are laboring under poor titles which bring no credit to our chosen profession. Let us do all we can to make sure the public recognizes us as foresters. It may take many years to accomplish much of a change in title terminolgy, but this would certainly be a simple way of bringing more recognition to professional foresters.

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Book Reviews

Fundamentals of Forestry Economics

By William A. Duerr. 579 pp. Illus. McGraw-Hill Book Company, Inc., New York. 1960. $9.50.

Forest economics is not an easy subject to teach to undergraduate forestry students, but whatever the difficulties may be, they can no longer be ascribed to inadequate textbooks. Publication of Professor Duerr's book follows close on the heels of Albert Worrell's *Economics of American Forestry*.

A reviewer is tempted to compare these two books. Both are professional works and up-to-date; they cover the same general field; and presumably, they aim at the same audience. Professors of forest economics may be hard put in deciding which to adopt for classroom use. This reviewer won't throw much light on the issue other than to point out that Worrell's text is easier for beginning students to grasp, but that Duerr's text is more inclusive in subject matter and more advanced in its treatment.

Professor Duerr's book has been in process a long time. For several years his manuscript has been available to a number of forestry schools as a highly polished text in processed form. But Professor Duerr is not one to rush into print. He has labored over his manuscript, polishing and refining at length. The result is a fine book, the carefully written product of a highly trained mind and skilled hand. Professor Duerr has not only written authoritatively about a multitude of subjects which come under the heading of forestry economics; he has tied them together into a unified whole. A wide acquaintance with technical literature lies behind the treatment of individual subjects, but of more importance, the author offers an abundance of his own research and original thinking. In the latter respect, he has gone far beyond the achievement of most textbook writers.

The 33 chapters that make up *Fundamentals of Forestry Economics* are grouped into five parts: (1) introduction; (2) production firms and their supply; (3) demand and its meeting with supply; (4) institutions of the forest economy; and (5) the forest economy at large.

Part I outlines briefly the characteristics and resources of the forest economy and relationships between society and the individual which affect the forest economy. Part II, comprising twelve chapters, is concerned with the economic principles governing the behavior of individual producing firms —their use of the agents of production and their supply responses to the influence of price and cost. Part III, made up of seven chapters, includes a discussion of demand, the meeting of supply and demand in the market, and marketing. Part IV, with five chapters, is pointed toward institutions affecting forest economic activity; centers of influence in business, labor, and government; and tenure, taxation, credit and insurance. Part V, comprising five chapters, includes a broad discussion of the forest economy of the world and probes into the problems of planning public forestry programs.

The author attempts, through such devices as the suggestion of questions to his readers and the occasion adoption of conversational language, to convey the notion that his book has been written at an elementary level. But *Fundamentals of Forestry Economics* is much more than a beginner's textbook. Much of the material included can be termed, at the minimum, as intermediate level economics. The depth of treatment will prove very useful to practicing foresters and even to trained forest economists, but this source of strength in the book may prove to be a problem to forestry students whose previous exposure to general economics has been limited to one or two courses.

With only the above mild reservation in mind, this reviewer recommends Professor Duerr's book unqualifiedly as a college text or as a source of stimulation and insight to practicing foresters. This reviewer has been impressed by the comprehensiveness of *Fundamentals of Forestry Economics*, the generally excellent balance achieved among the diverse topics treated, the good writing, and the sustained high level of technical competence in relating economic theory to forestry. Professor Duerr deserves high praise for his achievement in adding an outstanding volume to technical forestry literature.

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Michigan State University, East Lansing

The Wild Mammals of Missouri

By Charles and Elizabeth Schwartz. 341 pp. Illus. University of Missouri Press and Missouri Conservation Commission. Available from University of Missouri Press, Columbia. 1959. $5.95.

Charles and Elizabeth Schwartz are a husband and wife team of zoologists with a nationwide reputation as scientists, writers, illustrators, and photographers of wildlife. They have together produced many articles in both technical and popular journals, several books, and such award-winning movies as "Bobwhite Through the Year" and "A Way of Life." These received, respectively, a gold medal for 1953 at the International Sports Film Festival in Rome and a blue ribbon at the American Film Festival in 1959.

The Wild Mammals of Missouri is no exception as a sample of the ability of the Schwartzes to produce work of interest for laymen and of value for the scientist. Sixty-two species of wild mammals established in Missouri are presented by text and artistic illustration. Species are divided into orders, with a key to identification of species within each. Species description, distribution, habitat, importance, management, and control are discussed. There are extensive bibliographical reference lists and 400 illustrations. In addition to the foregoing, 5 species which formerly occurred in the state are briefly discussed as are 13 species whose natural ranges are so close to the state that occasional specimens may be observed.

The centralized geographical location of Missouri and the fact that the geologic history of much of its area has permitted one of the continent's most ecologically complex plant-animal associations make this book of more than state or even regional significance. Its high quality of presentation, scientific reliability, and popular appeal should do even more to assure its wide use by layman and scientist.

ARTHUR B. MEYER

Growth and Yields of Natural Stands of the Southern Pines

By F. X. Schumacher and T. S. Coile. 97 pp. and appendix. Illus. T. S. Coile, Inc., Durham, N. C. 1960. No price indicated.

JOURNAL readers over the past 35 years have had many samples of the ingenious thinking and concise writing of Schumacher and Coile, separately and together. This small book is another important contribution to the literature of forest measurements. It should be particularly important to the managers of southern pine forests. It should also be of great interest to those who teach and study forest mensuration.

The authors first present yield tables for well stocked stands of the six major southern pines (loblolly, slash, longleaf, shortleaf, pond, and sand) that are noteworthy for their compactness. These are followed by a section on the calculation of future yields of even aged stands. This section depends heavily on the 67 charts which comprise a large part of the book. A separate series of charts is given for each of the six species and show stand development in terms of height of dominant stand, basal area, and numbers of trees per acre by site index classes. Both basal area and number of trees are related to basal area at age 20 to adjust for varying degrees of site utilization.

To obtain volume, use is made of charts (also presented as tables in the appendix) that show average volumes in cubic feet per tree in relation to stand diameter and height. Volume in cords and board feet is estimated from corresponding ratios read from charts.

The appendix contains, in addition to the volume tables, the basis for the yield tables and the development charts. Their discussion of "stocking percentage" is of particular interest; it is defined as " . . . the percentage ratio of calculated ground area to actual ground area . . ." Stocking percentage of a well stocked stand is 100 which indicates there are enough trees, and not too many, to completely utilize the site. This differs from the older concept of "normal stocking" being, as they point out, ". . . a property of its basic data." An optimum basal area for a particular combination of stand height and age is inferred which may be in conflict with those who have reported growth varies little over a wide range of stand density. In any event, stocking percentage is an abstract resultant of the plots selected to represent "well stocked stands."

Another interesting chart shows change of stocking percentage with age of stand. The hypothesis is that stocking percentage of a particular stand approaches 100 as the stand grows older. It is made specific by plotting log (stocking percentage) over the reciprocal of age and drawing a straight line to connect this point with (2, 0).

In using these, or other yield tables, it is important to remember what they are. These tables show averages in relation to age and site derived from measurements at one point in the life of the stands sampled. Their first use is to estimate yield, what is present, on a particular site at the given age. Derived uses include estimation of growth and future yield. When properly used these tables should be of great value for these purposes.

I would like to commend the authors for terse treatment of a difficult and complex subject. This is a book that should be read and digested by those who manage forest land in the southern pine region. It should be carefully studied by forest mensurationists elsewhere for possible application of the reported methods to other species. It is a notable addition to the theory of yield table preparation and use.

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Evergreens for Every State

By Katherine M-P. Cloud. 227 pp. Illus. Chilton Company, Book Division, Philadelphia. 1960. $4.95.

The author has brought together informatioin concerning the principal ornamental evergreens which can be used with confidence in the continental states. (Hawaii is not included in this treatise.) This includes an excellent section on pest control, soil requirements, protection, and pruning (with a somewhat sketchy description of topiary, espalier, and bonsai culture), and a good discussion on propagation.

The chapters on the discussion of the principal species, their requirements, values, and disadvantages comprise two-thirds of the book. This is carefully and adequately handled.

A questionnaire was sent by the author to a recognized authority on ornamentals in each state (in many cases, the Horticulture Department of the State University) and the replies are printed in a section of the book. This gives the reader an opportunity to compare culture practices in the different areas and recommended species. It also gives to those interested the names and addresses of plant authorities in each state, in itself a very valuable item.

The illustrations are numerous and well-selected. This reviewer would have enjoyed seeing some of the illustrations in color though the book would doubtless not be available at the present price if this had been done.

ROBERT R. PATON
Ohio Forestry Association, Inc.
Columbus

"Conscience, principles, patriotism, honor, devotion to duty and to one's comrades, unswerving justice, compassion, resistance to temptation, refusal to submit to atempted intimidation, self-control, and many other much-admired qualities, are evidences of values, attitudes, and beliefs so deeply ingrained that self-interest, personal desires, and all manner of other stimuli and cues are rendered nugatory as influences on behavior. The same applies to the zeal, conscientiousness, and integrity of the men in the Forest Service; these traits are so thoroughly infused into them that the Service has never been touched by so much as a breath of scandal, although it is the custodian of properties worth hundreds of million of dollars, has handled many hundreds of millions in receipts and expenditures, and is responsible for a program that was beset by fraud and dishonesty for much of the last third of the nineteenth century."—From *The Forest Ranger* by Herbert Kaufman (Johns Hopkins Press).

Publications of Interest

A 2-page folder entitled *CZ is Proud of Its Forest Land Ownership* has been published by Crown Zellerbach Corp., Southern Timber Division, Bogalusa, La. The folder reports on the extent of company ownership in Louisiana and Mississippi, the way that land is being handled for increased production, and the role of productive forests and the forest industry in community welfare. The report shows that the bulk of acreage acquired came from large corporation ownership, with only 3 percent of the acreage acquired from owners of less than 100 acres.

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Maryland Forests is a 32-page bulletin by Craig D. Whitesell, research forester of the Maryland Department of Research and Education, published in cooperation with the Department of Forests and Parks and the Board of Natural Resources. It is a concisely written description of the forest resource of the state, its importance, and problems and progress in its protection and management. Illustrated with photographs, drawings, and charts, the bulletin draws primarily on the Forest Service publication *Timber Resources in Maryland* for data and statistics. The bulletin is prepared for public information.

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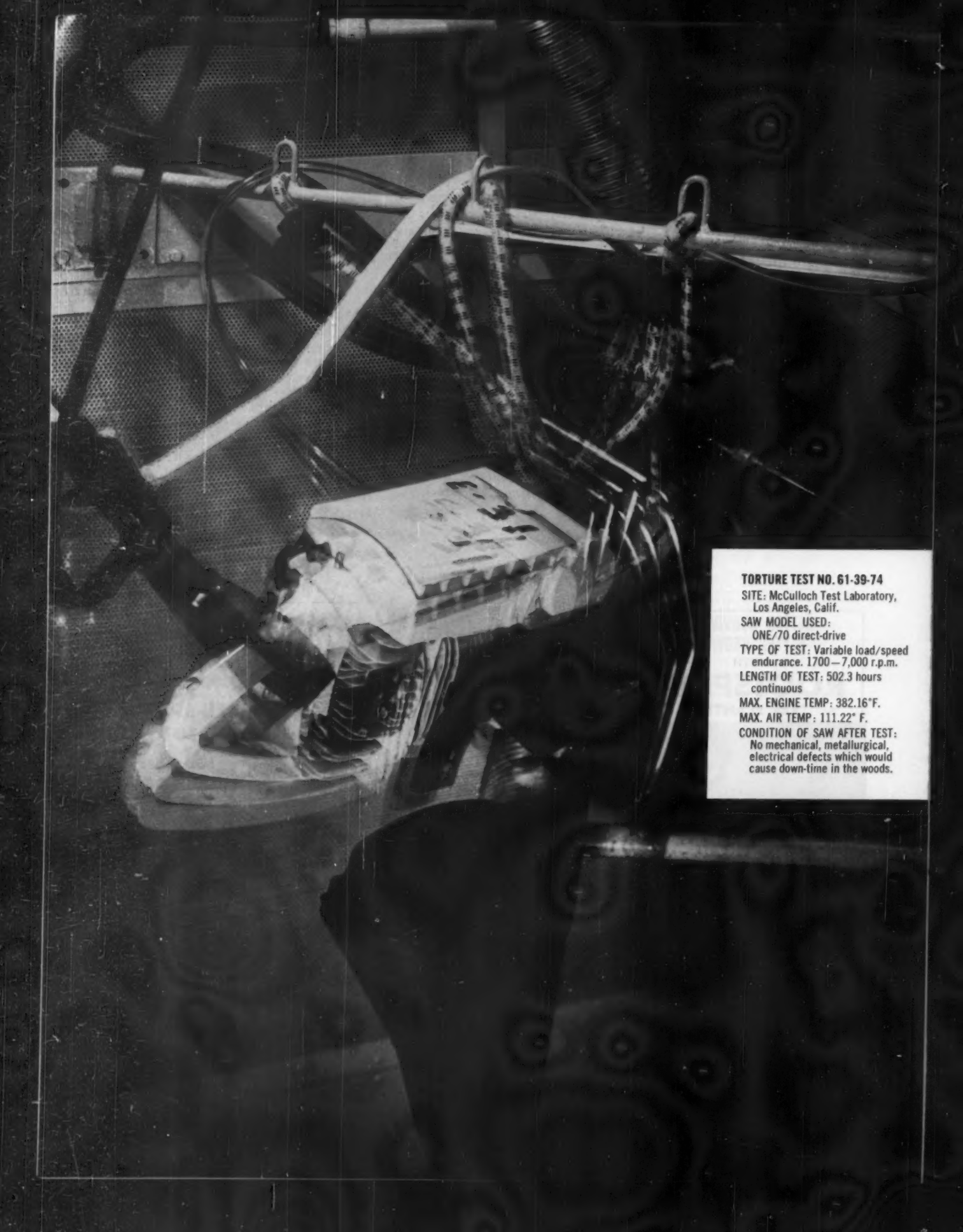

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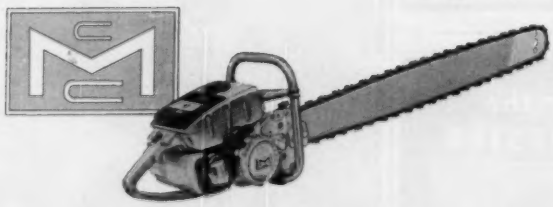

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Current Literature

Compiled by LOIS MCALLISTER, *Assistant Librarian, State University College of Forestry at Syracuse University*
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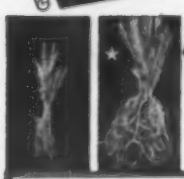

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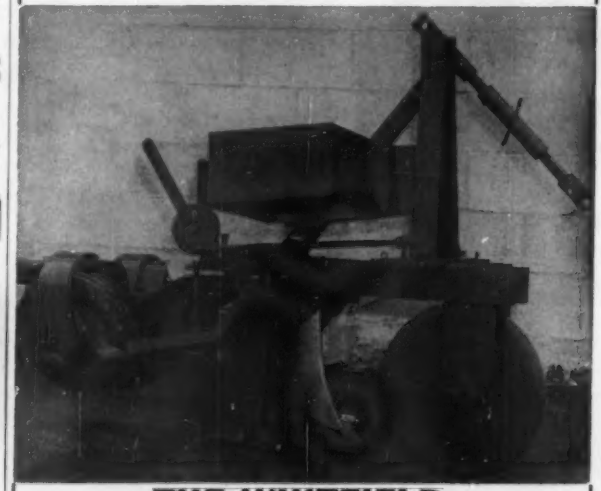

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Coming Events

Puget Sound Section

The Puget Sound Section will hold its meeting at Port Angeles, Wash., May 13-14, 1960.

Ozark Section

The summer meeting of the Ozark Section will be held at Salem, Mo., June 2-4, 1960. Float trips on Current and Jacks Fork Rivers are planned for June 2; field trips on June 3; and dedication of Licking Nursery as George O. White Forest Tree Nursery on June 4.

Kentucky-Tennessee Section

The summer meeting of the Kentucky-Tennessee Section will be held at the La Citadelle Motel, Hazard, Ky., June 10-11, 1960. A field trip is planned on June 10 to the University of Kentucky's Robinson Forest.

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Council's Column

Is Forestry Education Keeping Up With The Fast Moving Forestry Profession?

Within the last few years nearly every issue of our JOURNAL has carried one or more articles which indirectly have emphasized the increasingly complex technical background required of today's professional forester. To hold a responsible job this forester should have sufficient statistical background to understand techniques involved in permanent inventory, in growth prediction, and in other mensurational aspects; enough basic morphology and physiology to apply genetic principles; the ability to interpret aerial photographs; sufficient chemistry and ecology to deal intelligently with soils, silvicides or systemics. Protection from fire now involves techniques emanating from basic physics and meteorology, intelligent use of heavy equipment including aerial bombing with water and chemicals, and large-scale organizational problems resembling those present in a military engagement. Intelligent handling of complex public relation problems and understanding of economic principles relating to production and costs are becoming increasingly the responsibility of the professional forester.

I would like to raise the question as to whether the schools have fully recognized these new demands, and if so whether they are modernizing their curricula and standards to keep pace with these fast-moving developments. There is no question but that the curricula have been and are being strengthened. The programs of 30, 20, or even 10 years ago differ considerably from the requirements of today. But my question is this. Are the schools adequately meeting the challenge? Are they providing training of the quality and quantity that will be sufficient to meet the demands that will be placed on professional foresters 10, 20, and 30 years hence? To cover the substance of this question more specifically, I would like to pose the following:

1. Are forestry schools attracting enough young men of ability to enable them to set their standards to a sufficiently high level to insure truly professional competence in their graduates?

2. Are the educational programs geared to the level of superior students or to a not very high average ability, with little to stimulate or challenge the really able? What programs have been set up for the superior students?

3. Are forestry curricula giving proper emphasis to the basic sciences: mathematics, botany, chemistry, genetics, physiology, physics? These are the disciplines which graduates must master to adjust to new technologies.

4. Is there still too much emphasis on applied or vocational type training, such as thinning, planting, cruising, marking, logging, and machining, important as these may be, but which are not really mentally challenging to the student and do not equip him to solve problems of future developments in forestry technologies? In other words, is the emphasis too much on current methodology and training and not enough on basic principles which are timeless?

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5. Are educational programs recognizing that the professional forester will be required to become more and more a business administrator, dealing with problems such as cost-price ratios, taxes, legal restrictions, and public relations?

6. Is the recent trend to establish increasing numbers of small forestry schools with limited budgets, staffs and facilities good for the profession?

7. Has not our profession, which according to the March 1960 JOURNAL has granted 33,822 degrees, arrived at the point earlier reached by professions such as engineering, law and medicine, where there is no longer a place for professional training which does not measure up to high academic standards? Can we afford to accredit programs whose graduates will not be of true professional stature?

8. Finally, are enough of our educational programs recognizing their responsibilities to contribute to the fields of knowledge of our profession through meaningful research contributions?

Adequate answers to these questions are essential to the well-being of our profession, and to me the answers available today are not satisfactory. We are a rapidly growing profession, occupying an increasingly important place in the economy of our country, and foresters are moving up into important policymaking positions. To achieve the high professional status which is our due, we cannot afford to allow our educational programs to drop behind the fast moving pace of the profession. Nearly all professional foresters are alumni of forestry schools. Are we actively interested in helping our alma mater to achieve high excellence? Are we as a profession demanding enough of our schools? Are we challenging their programs, philosophies and records of achievement? Many of our schools are doing a fine job. Many others would welcome pressure from the profession, a pressure which would give them the support necessary to do a good job. Still other forestry educational programs do not have the support, facilities, or supporting strengths necessary to attain excellence.

Educational standards are of vital importance to all foresters. Let me urge you to read the article by H. Clepper[1] in the January 1959 JOURNAL, the articles by Duffield[2] and Davis[3] in the May 1959 issue, the article by Hardee[4] in the October 1959 issue, and the article by Miles[5] in the March, 1960 JOURNAL. Each of these faces squarely some of the problems confronting forestry education, and each offers varying thoughtful solutions. It is most fortunate that the Society study of forestry education under the able direction of Dr. Dana is well under way. This study should give us sound guideposts for progress. Let it be hoped that the profession will not continue to be satisfied—in fact will not tolerate—an educational system which in any way does not add up to high standards of excellence.

RICHARD J. PRESTON, JR.

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TOM GILL (center), of the Charles Lathrop Pack Foundation, belatedly received his gold medal from the President of Mexico, Adolfo Lopez Mateos, at the meeting of the Washington Section, SAF, March 17, at the Presidential Arms.

The medal was bestowed for Mr. Gill's contributions to tropical forestry and his books on the forests of Mexico. He is the first non-Mexican citizen to receive this civil forestry merit medal.

Richard E. McCardle (left), chief of the Forest Service, presented the medal to Mr. Gill, on behalf of the Mexican government. Mr. Gill was not in Mexico to receive it when it was presented at the forestry congress there in August, 1959.

Representing the Mexican president at the presentation was Gonzalo Blanco, Agricultural Attache of the Embassy. In describing Mr. Gill's books on Mexican forestry, he said they should be entitled "Bible for Survival." The medal was given as a token of gratitude for Mr. Gill's technical help and his promotion of better understanding between the two countries.

Washington Section Holds All-Day Annual Meeting

The annual all-day meeting of the Washington (D. C.) Section was held in the Presidential Arms on March 17. Attendance totaled 200.

Featured on the morning program was a panel discussion on "Competing Demands for the Use of Forest Lands: Is Multiple Use the Answer?" Maurice K. Goddard, secretary of Forests and Waters in Pennsylvania, was the moderator.

Three speakers participated: Samuel T. Dana, dean emeritus of the University of Michigan School of Natural Resources; Marion Clawson, director of studies in land use and management, Resources for the Future, Inc.; and H. R. Glascock, Jr., forest counsel for the Western Forestry and Conservation Association.

Presiding at the luncheon was James E. Owen, Section chairman. A highlight was the presentation of a gold medal by the Mexican Government to Tom Gill. In behalf of the U. S. Government, which was temporary custodian of the medal, Richard E. McArdle made the presentation.

Lincoln R. Thiesmeyer, president of the Pulp and Paper Research Institute of Canada, was the luncheon speaker.

The afternoon program began with an address "Conservation Education: A Challenge to Professional Foresters," by George L. Fersh, director of conservation and resource-use education for the Joint Council on Economic Education in New York State.

An illustrated discussion of "Color Photography: A New Tool in Forest Management" concluded the program. The speakers were Albert G. Hall, consulting forester, and Robert C. Heller, Division of Forest Insect Research of the Forest Service.

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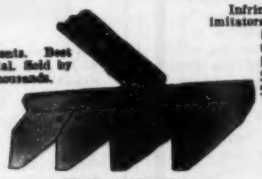

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Third Chapter Formed in Northern Rocky Mountain Section

An Eastern Montana Chapter of the Society of American Foresters was organized at a meeting in Bozeman February 27, according to J. E. Sanderson of Libby, Mont., chairman of the Northern Rocky Mountain Section.

Sanderson reports that the new Chapter is the third in the Section, with others located at Missoula and Libby, Mont. The group will meet in June to install officers who are to be elected by mail ballot.

Alaska Section Forms Chapters

Recently the executive committee of the Alaska Section unanimously approved petitions forming three chapters: Ketchikan, Juneau, and Interior.

The Juneau Chapter has since elected the following officers:

Chairman—Austin E. Helmer, Alaska Forest Research Center.

Vice Chairman—Edward J. Hoffmann, Bureau of Land Management.

Secretary-Treasurer—Stanley R. Johnson, U. S. Forest Service.

Walter J. Rust, Bureau of Land Management, Anchorage, was appointed pro tem chairman of the Interior Chapter, and Carl N. Wilson, U. S. Forest Service, Ketchikan, was appointed pro tem chairman for the Ketchikan Chapter.

A Resolution Concerning CSC Examination Titles

Whereas: The United States Civil Service Comission did issue on January 20, 1960, an examination Announcement No. 5-21-2 (1960), PES 2079, Unassembled, Title: Forestry Aid, and,

Whereas: Those applicants who are rated as qualified by examination will be eligible to positions as Forestry Aids, Grade GS-5 through GS-9, and,

Whereas: The work of those who are so rated will be incident to the management, development, and care of federally owned or federally controlled forest lands and involved in duties such as those connected with timber management, management of other forest resources, and care of forest recreational areas, and,

Whereas: The minimum requirements for obtaining a GS-5 rating under this examination is stated to be 7 seasons of total experience, and for a GS-9 rating 13 seasons of total experience, and such individual seasons are acknowledged to be a minimum of three months, and,

Whereas: Such experience may be gained in any field of forestry or in related fields such as range management, farming, ranching, forest or range fire control, soil and water conservation activities, or in similar fields, and,

Whereas: Appropriate education of any kind, including high school, may be substituted up to a maximum of five seasons of experience, at the rate of one academic year of study for one season of experience.

Therefore: Be It Resolved, that the Southeastern Section of the Society of American Foresters, does strongly disapprove of the use of the term "Forestry" in the title of said examination; or any other inference in said announcement that persons so rated are foresters, or are capable of assigning, or directing the work of management, conservation development, and protection of timber, range, or other forest resources; and,

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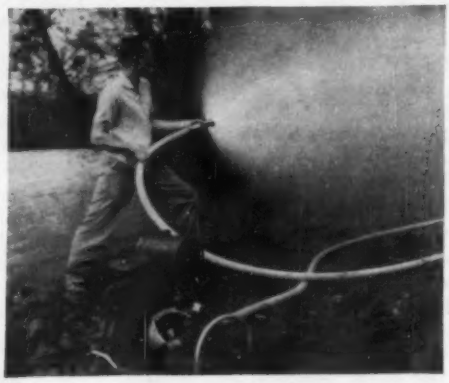

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Be It Further Resolved: That hereafter, the United States Civil Service Commission restrict the use of the terms "Forestry" or "Forester" to those examinations which require the applicant to hold a degree in forestry equal or comparable to that obtained by graduation from an accredited department, school, or college of forestry, and,

Be It Further Resolved: That copies of this resolution be forwarded at once by the Secretary of the Southeastern Section, to: United States Civil Service Commission, Washington, D. C.; Board of U. S. Civil Service Examiners, Nashville, Tenn.; president, vice-president, executive secretary, all members of the Council, and all chairmen of the Sections and Chapters of the Society of American Foresters; all U. S. Senators and Representatives from the states of Georgia, Florida, and Alabama; all heads of Departments, Schools, or Colleges of Forestry in the United States.

Editor's note.—Readers are referred to the Society Affairs item on page 333 of the April issue of the JOURNAL. Forest Service officials met with representatives of the SAF Council and forestry educators in Washington, D. C., on February 18. Dean R. J. Preston, chairman of the SAF Committee on Civil Service, reports on this meeting and further plans involving explanation and discussion of the matter.

New England Section Adopts Policy Statement on Aerial Spraying

The New England Section has endorsed the aerial application of insecticides as a weapon of last resort against forest defoliators. This action was taken in view of public concern in the Northeast over aerial spraying for control of spruce budworm and gypsy moth and upon the recommendation of a committee appointed to consider the evidence bearing on the controversy.

The Section qualified its endorsement by limiting it to cover only the use of DDT at rates not exceeding one pound per acre in situations where prior studies had shown that large-scale damage to timber and other natural resources would result from failure to spray. It also urged that agencies resorting to the practice seek to make the public aware of the reasons for their action before spraying. The Section endorsed intensified investigation of the techniques and effects of aerial spraying as well as greater efforts to publicize not only the risks of spraying but also such advantages as could be shown to exist. It pointed out that the risk of damage to fish populations dictated extreme precautions against the accidental spraying of lakes and streams.

The Section deplored the tendency of some opponents of aerial spraying to resort to false and misleading statements in the public press or, in other instances, failure to attach any importance to the values and resources protected by insecticides. It pointed out that publicity of this kind had an adverse effect on efforts to protect the forest.

The Section acted on the basis of a report by a committee consisting of Henry I. Baldwin, Lowell Besley, and Raymond C. Brown, with William P. House as chairman. This committee was appointed to study the subject after an earlier resolution had failed of adoption; its recommendations were acceptable to a substantial majority.

The summary of the report of this committee included the following observations and findings:

Protection of forests from insect damage is a necessary part of management for multiple use, not only for protection of timber values but also those of wildlife and fish, watershed and recreation. During the past 15 years, 34 million acres of North American forests have been sprayed with DDT for control of forest pests. Except for one major kill of salmon in New Brunswick, another in British Columbia, and a doubtful one in Montana, intensive observations have shown the proven mortality of fish and wildlife caused by DDT to be minor. The unquestionable existence of such risks calls for intensified efforts to minimize damage by improved spraying techniques, close supervision, and the development of safer chemicals.

The values at stake in spruce budworm areas include millions of cords and board feet of growing stock that represent a vital part of the economic foundation of those areas; there is ample evidence that unchecked defoliation has resulted in widespread loss of timber. With the gypsy moth, the major danger is the westward and southward spread of the insect from currently infested areas of the Northeast into 100 million acres of susceptible hardwood types; this would not only threaten valuable timber but also represent a substantial increase in the public nuisance involved. The risks

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of damage and the actual damage attendant on aerial spraying must be balanced against the values that would be lost by failure to control these insects; these values are great enough to justify the risks.

Some segments of public opinion are fearful of widespread tampering with the environment by chemical spraying but are unaware of the risks of *not* controlling forest insect pests.

DAVID M. SMITH
Chairman, New England Section

Norman G. Jacobson (1887-1960)

Norman G. Jacobson, 73, of Tacoma, Wash., died of a heart attack on March 10.

Born June 1, 1887, in Saukville, Wis., he was graduated in forestry at the University of Minnesota with the B. S. F. degree in 1910.

In that year he entered the U. S. Forest Service as a forest assistant, and during the next decade served on several national forests in Oregon, becoming supervisor of the Deschutes in 1917.

Following two years in the mercantile business, he joined Hall, Kellogg and Company, Chicago, Ill., in 1922 as forest engineer.

In 1924 he became affiliated in a consulting capacity with the St. Paul and Tacoma Lumber Company, the Shevlin-Hixon Company, and the Brooks Scanlon Lumber Company. He also worked on special projects for the Deschutes Forest Protection Association, and the Western Forestry and Conservation Association.

Mr. Jacobson became forester, later chief forester, for the St. Paul and Tacoma Lumber Company about 1936. He retired from the company (since acquired by St. Regis Paper Company) several years ago.

He had been a SAF member since 1924, and was a former chairman of the Puget Sound Section.

Laurence G. Jolley (1910-1960)

Laurence G. Jolley of Portland, Ore., died February 25.

Born in Seattle, Wash., August 28, 1910, Mr. Jolley was graduated from the University of Washington College of Forestry in 1933. During the summers of 1930 and 1933 he worked as lookout and fireman on the Olympic National Forest and as a forestry technician in the CCC Camp in the State of Washington. In 1935 he was assigned to the Division of Information and Education in the regional office of the U. S. Forest Service in Portland.

In 1940 he worked as assistant ranger on the Colville National Forest, and was promoted to district ranger in charge of the Quilcene district on the Olympic Forest in 1942. He became fire staff assistant on the Okanogan Forest in 1944, and was advanced to the position of assistant supervisor on the Mount Hood Forest in 1946. In 1950 he was made forest supervisor of the Rogue River National Forest.

Since 1951 Mr. Jolley had been assistant regional forester in charge of the Division of Information and Education, U. S. Forest Service, Portland, Ore. He was known throughout the Northwest for his forestry activities. He became a member of the SAF in 1937.

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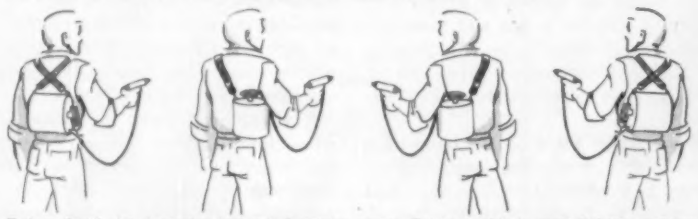

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Membership Applications and Advancements

Proposals for admission, advancement, and reinstatement received in the Society office during the month of March are listed below.

Action on the eligibility of those proposed for membership as listed below will be taken by the Council as of May 1960.

Communications from the voting members regarding the membership eligibility of these persons should be received in the Society office prior to that date.

Allegheny Section

Student Grade

PENNSYLVANIA STATE UNIVERSITY

Gorby, D. W. — Rappaport, A. N.
Hirt, R. L. — Reeder, T. N.
Warren, W. B.

Junior Grade

Gauger, W. H., Service Forester, Dept. of Forests & Waters, Mercer, Pa. Pa. State, BSF, 1959.

Hill, J. S., Research Chemist, Johns Manville Research Center, Manville, N. J. Univ. of N. H., BSF, 1959.

Oaks, D. P., Forester, Pa. Dept. of Forests & Waters, Bloomsburg, Pa. Pa. State, BSF, 1959.

Member Grade

Leslie, R. E., Forester, Armstrong Forest Co., Johnsonburg, Pa. Univ. of Maine, BSF, 1956 (Junior 1956).

Appalachian Section

Student Grade

NORTH CAROLINA STATE COLLEGE

Ball, W. R. — Smith, J. H.
Blizzard, D. D. — Tyson, R. L.
Jeffries, K. F. — Waters, J. E.

Junior Grade

Hampton, L. A., Specialist, N. C. State College Extension Service, Asheville, N. C. (Reinstatement).

Reger, M. V., Dist. Mgr., Champion Paper & Fibre Co., Rutherfordton, N. C. (Reinstatement).

Member Grade

Corbett, K. M., P. O. Box 251, New Bern, N. C. (Junior 1953).

Hicks, J. R., 37 Monument Ave., Harrisonburg, Va. (34R56).

Jolly, A., 921 Marston St., Salem, Va. (47R58).

Millers, A. W., Purchasing Agent, Hickory, N. C. (Junior 1951).

Penland, R. F., P. O. Box 7084, Asheville, N. C. (51R55).

Price, E. B., Asst. State Forester, S. C. State Comm. of Forestry, Columbia, S. C. (Reinstatement).

Purvis, G. M., Asst. Dist. Forester, Catawba Tbr. Co., Lancaster, S. C. La. State, BSF, 1956 (Junior 1956).

Roy, G. K., Project Forester, USFS, Harrisonburg, Va. W. Va. Univ., BSF, 1954 (Junior 1954).

Stingley, J. M., 11 Bayview Dr., Jacksonville, N. C. (36R57).

Varner, D. R., 1102 Newton Dr., New Bern, N. C. (Junior 1953).

Wendel, G. W., Southeastern Forest Expt. Sta., New Bern, N. C. (Junior 1951).

Wessell, J. C., Mgr. of Forestry, N. C. Prison Dept., Raleigh, N. C. N. C. State, BSF, 1953 (Junior 1956).

Central Rocky Mountain Section

Member Grade

Allen, H. V., Forester, USFS, Denver, Colo. (Reinstatement).

Central States Section

Student Grade

PURDUE UNIVERSITY

Smith, G. M.

Junior Grade

Cramer, R. W., Instructor, Caterpillar Tractor Co., Peoria, Ill. (Reinstatement).

Member Grade

Beazley, R. I., Prof. Southern Ill. Univ., Carbondale, Ill. Yale Univ., MF, 1950, Purdue Univ., Ph.D., 1954 (Junior 1954).

Nowak, C. R., City Forester, LaPorte, Ind. (Junior 1952).

Columbia River Section

Student Grade

OREGON STATE COLLEGE

Farr, G. H. — Smith, W. H.
Harvey, W. L. — Stone, D. R.
Meusch, J. D. — Waitt, R. E.
Rondeau, R. A. — Warner, W. R.

Junior Grade

Bohlig, R. Q., Dist. Forester, Weyerhaeuser Co., Longview, Wash. (Reinstatement).

Carolin, V. M., Entomologist, Pacific Northwest Forest & Range Expt. Sta., Portland, Ore. (Reinstatement).

Hazen, H. H., Forester, USFS, Waldport, Ore. Univ. Mass., BSF, 1959.

Klahn, A. E., Forester, USFS, Baker, Ore. Colo. State Univ., BSF, 1941.

Larsen, A. T., Director, Ore. State Board of Forestry, Salem, Ore. (Reinstatement).

Worstell, R. L., Recreation & Lands Staff, Willamette Nat'l. Forest, Eugene, Ore. (Reinstatement).

Member Grade

Madsen, R. S., Sr. Forester, Ore. State Board of Forestry, Salem, Ore. (Junior 1954).

McRorey, R. P., Asst. Chief, USFS, Portland, Ore. (Reinstatement).

Remmy, K. F., Forester, Bur. of Land

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Mgmt., Roseburg, Ore. Univ. Calif., BSF, 1956 (Junior 1956).

Affiliate Grade

Ross, R. N., Forestry Aid, USFS, Ukiah, Ore.

Associate Grade

Krieg, G. W., Commissioner, Hood River Co., Hood River, Ore.

Gulf States Section

Student Grade

LOUISIANA STATE UNIVERSITY

Hawkins, J. L.

Junior Grade

Noel, J. D., Asst. Dist. Forester, Nebo Oil Co., Minden, La. Univ. Mich., BSF, 1956.

Woodard, R. E., Forester, Woodard Walker Lbr. Co., Inc., Taylor, La. La. Polytechnic Inst. BSF, 1953.

Member Grade

Campbell, T. E., Research Forester, A. J. Hodges Industries, Inc., Many, La. La. State, BSF, 1952 (Junior 1954).

Dickerson, H. C., Mgr., Hart Lbr. Co., Jasper, Texas (AF51J53).

Mixon, J. E., State Forester, Baton Rouge, La. (Reinstatement).

Richard, W. E., Dist. Forester, Southwestern Settlement & Development Co., Kirbyville, Texas. La. State, BSF, 1954 (Junior 1954).

Smith, C. D., Forester, Texaco Inc., Lafayette, La. Ala. Tech., BSF, 1956 (Junior 1956).

Inland Empire Section

Student Grade

UNIVERSITY OF IDAHO

Bartlett, K. H.

Junior Grade

Hoeman, J. V., U. S. Army, Fort Ord, Calif. Colo. State, BSF, 1959.

Member Grade

Powell, H. D., Forester, USFS, Curlew, Wash. Colo. State Univ., BSF, 1954 (Junior 1954).

Affiliate Grade

Link, J. E., Field Supv., Dept. of Natural Resources, Colville, Wash.

McCollister, C. J., Camp Foreman, Potlatch Forests, Inc., Headquarters, Idaho.

Perkins, R. P. Tbr. Mgmt. Asst., USFS, Princeton, Idaho.

Intermountain Section

Student Grade

UTAH STATE UNIVERSITY

Avery, C. C. Ireland, W. E.

Junior Grade

Moorhead, J. R., Dist. Forest Ranger, USFS, Cascade, Idaho, Univ. Calif., BSF, 1956.

Morgan, R. E., Forester, USDA, Boise, Idaho, Utah State, BSF, 1951.

Settles, R. L., Forester, USFS, Boise, Idaho. Univ. Idaho, BSF, 1958.

Member Grade

Harry, G. B., Asst. Chief, National Park Service, Moose, Wyo. Univ. Mich., BSF, 1950 (Junior 1956).

Heikkenen, E. A. Forester, USFS, Garden Valley, Idaho. Univ. Mich., BSF, 1956 (Junior 1956).

Steffens, J. D., Forester, USFS, Mountain Home, Idaho. Univ. Maine, BSF, 1955 (Junior 1956).

Wheeler, R. A., Dist. Forest Ranger, USDA, Cokeville, Wyo. Utah State, BSF, 1955 (Junior 1955).

Kentucky-Tennessee Section

Junior Grade

Grafton, J. E., Forester, USFS, Stearns, Ky. W. Va. Univ., BSF, 1958.

Member Grade

Bentley, A. R., Co-ordinator, Hiwassee Land Co., Calhoun, Tenn. Univ. Wash., MF, 1951 (Junior 1954).

Bowers, J. L., 407 Watauga Ave., Elizabethton, Tenn. (Junior 1953).

New England Section

Student Grade

UNIVERSITY OF MASSACHUSETTS

Creelman, A. N. Hubbard, D. E.
Forest, D. J. Pease, R. I.
Thompson, W. A.

UNIVERSITY OF NEW HAMPSHIRE

French, C. B. Heath, E. I.
Spafford, F. L.

Junior Grade

Sargent, J. E., Co. Forester, Extension

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FUNDAMENTALS OF FORESTRY ECONOMICS By William A. Duerr, *State University of New York College of Forestry, Syracuse University.* The American Forestry Series. 576 pages, $9.50.

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Member Grade

Billings, J. L., Co. Forester, Farm Bur. Office, Woodstock, Vt. Univ. Mass, 1950 (Junior 1954).

Affiliate Grade

Bradder, W. E., Consulting Forester, Sable Mt. Corp., Rutland, Vt.
Gooley, W. R., Forester, Maine Forest Service, Augusta, Maine.
Pollock, W. S., Canadian International Paper Co., Quebec, Canada.
Reeve, W. L., Sharon Publishing Co., Sharon, Mass. (Reinstatement).
Woodward, R. V., Field Supv., Blister Rust Control, Laconia, N. H.

New York Section

Student Grade

STATE UNIVERSITY OF NEW YORK

Dailey, F. D. — MacPherson, R. J.
Graham, D. L. — Momberger, G. L.
Jurgensen, M. F. — Ryan, G. D.

Junior Grade

Staley, J. M., Forest Pathologist, Northeastern Expt. Sta., Upper Darby, Pa. Mont. State, BSF, 1951.

Northern California Section

Junior Grade

Wright, L. H., 1020 High Street, Oakland, Calif. (Reinstatement).

Member Grade

Tryner, J. P., Dist. Supt., State Div. of Beaches & Parks, Eureka, Calif. (Reinstatement).

Ozark Section

Student Grade

UNIVERSITY OF MISSOURI

Coose, R. L. — Jones, B. L.
Crozier, R. G. — Loewenberg, B. J.
Deutsch, H. A. — Miller, D. R.
Ewing, F. E. — Patterson, E. L.
Fallert, R. A. — Reid, C. P. P.
Gibbs, J. B. — Vogt, A. R.
Watson, K. J.

Junior Grade

Student Eligible for Automatic Advancement

UNIVERSITY OF MISSOURI

Thompson, J. M.

Member Grade

Fox, W. H., General Partner, W. S. Fox & Sons, Pine Bluff, Ark., (Af47J56).
Grey, G. W., Farm Forester, Mo. Cons. Comm., Owensville, Mo. Univ. Mo., BSF, 1956 (Junior 1956).

Affiliate Grade

Ashworth, D. W., Forester, International Paper Co., Pine Bluff, Ark.
Baldus, L. G., Forester, International Paper Co., Morrilton, Ark.
Crouse, D. F., Forester, USFS, Hot Springs, Ark.
Duren, F. L., Forester, International Paper Co., Benton, Ark.
Francis, K. K., Asst. Dist. Forester, Dierks Forest Inc., Dierks, Ark.
Johnston, G. E., Asst. Dist. Forester, Dierks Forest Inc., Grannis, Ark.
McClendon, J. B., Forester, USFS, Glenwood, Ark.
Moore, J. L., Forester, International Paper Co., Benton, Ark.
Sirmon, G. E., Block Forester, Fordyce Lbr. Co., Fordyce, Ark.

Puget Sound Section

Student Grade

UNIVERSITY OF WASHINGTON

Grayson, K. G. — McCaslin, P. H.

Junior Grade

Abbott, R. F., Forester, USFS, Glacier, Wash. Univ. Maine, BSF, 1958
Abrahamson, D. P., Chemist, Crown Zellerbach Corp., Port Townsend, Wash. (Reinstatement).
Hansen, C. N., Forester, Co. of Pierce, Tacoma, Wash. Univ. Wash., BSF, 1959.
Kom, H. C., Forester, Northern Pacific Railway Co., Seattle, Wash. Mont. State, BSF, 1957.

Member Grade

Telford, R. C., Woods Mgr., Columbia Cellulose Co., Ltd., Terrace, B. C., Canada. Univ. Wash., BSF, 1939 (Junior 1954).

Affiliate Grade

Daniels, S. R., Dist. Administrator, Dept. of Natural Resources, Deming, Wash.
Dugger, W. W., Forester, Dept. of Natural Resources, Forks, Wash.
Fearon, R. R., Forester, USFS, Packwood, Wash.
Terry, N. D., Tbr. Cruiser, Weyerhaeuser Co., Centralia, Wash.
Westlund, H. E., Forestry Law Enforcement Officer, Dept. of Natural Resources, Sedro Woolley, Wash.

Southeastern Section

Student Grade

UNIVERSITY OF FLORIDA

Crooks, J. R. — Hemingway, G. B.
Estes, J. E. — Irons, E. C.
Garland, W. B. — Johnson, J. P.
Thompson, E. F.

UNIVERSITY OF GEORGIA

Coram, J. H. — Forsyth, J. E.
Hyatt, R. R.

Junior Grade

Dockery, E., Jr. Forester, Fla. Forest Service, Ocala, Fla. Univ. Ga., BSF, 1959.
O'Neal, J. P., Procurement Forester, Gulf States Paper Corp., Demopolis, Ala. (Reinstatement).

Member Grade

Bailey, W. M., Division Supt., International Paper Co., Panama City, Fla. (Junior 1954).
Barbaree, J. A., Mgr., Bacon & Bickley Pulpwood Co., Waycross, Ga. Univ. Ga., BSF, 1956 (Junior 1956).
Griffin, J. W., Unit Forester, International Paper Co., Jackson, Ala. La. State, BSF, 1956 (Junior 1956).
Hausman, D. W., Farm Forester, Fla. Forest Service, Ocala, Fla. Univ. Fla., BSF, 1956 (Junior 1956).
Lindau, A. H., Unit Forester, International Paper Co., Bronson, Fla. Univ. Fla., BSF, 1954 (Junior 1954).

Affiliate Grade

Arledge, L. U., Working Circle Forester, St. Regis Paper Co., Fargo, Ga.
Henker, G. G., Forester, Southern Tbr. Mgmt. Service, Inc., Birmingham, Ala.

Southwestern Section

Junior Grade

Sturm, D. C., Logging Eng., Southwest Forest Industries, Phoenix, Ariz. Colo., State Univ., BSF, 1955.

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Wyche, J. S., Forester, USFS, Alpine, Ariz. Colo. State Univ., BSF, 1958.

Member Grade

Lindquist, L. A., Asst. Dist. Forest Ranger, USDA, Jemez Springs, N. M. Iowa State, BSF, 1956 (Junior 1956).

Upper Mississippi Valley Section

Student Grade

IOWA STATE UNIVERSITY
Manwiller, F. G. Schelhaas, J. A. Shepard, R. A.

UNIVERSITY OF MINNESOTA
Erickson, W. C. Hall, J. T.

Junior Grade

Cushman, W. H., Asst. Area Forester, State Land Mgmt., Duluth, Minn. Univ. Minn., BSF, 1956.
Gill, T. S., Dist. Ranger, USFS, Virginia, Minn. (Reinstatement).
Hartwick, R. A., Dist. Ranger, USFS, Aurora, Minn. (Reinstatement).
Roberts, T. E., Forester, Chippawa Nat'l. Forest, Cass Lake, Minn. (Reinstatement).
Wolter, J. C., Forester, USFS, Ely, Minn. (Reinstatement).

Member Grade

Winters, E. J., Forester, Marathon Corp. of Canada, Ltd., Port Arthur, Canada (Junior 1953).

Affiliate Grade

Hesse, H. D., ACP Field Inspection, Minn. State Forest Service, St. Paul, Minn.

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Linge, R., Forest Ranger, State of Minn., Forest Lake, Minn.
Radke, L. A., Asst. Area Forester, Minn. Forest Service, Park Rapids, Minn.
Westra, H. E., Forest Ranger, State of Minn., Zimmerman, Minn.

Washington Section

Member Grade

Downs, A. A., Chief, Foreign Forestry Branch, USFS, Washington, D. C. (Reinstatement).

Wisconsin-Michigan Section

Student Grade

MICHIGAN COLLEGE OF MINING & TECHNOLOGY
Babboni, A. J. Landgraff, D. A. Reed, C. G.

UNIVERSITY OF MICHIGAN
Ernest, G. J. Whitmore, J. L.

Junior Grade

Hosking, R., Log Scaler, Goodman Lbr. Div., Newberry, Mich. Mich. Mining & Tech., BSF, 1950.
O'Brien, J. M., Forester, Sno Kist Tree Co., Cheboygan, Mich. Univ. Mich., BSF, 1960.
Rieck, C. E., Supv., Wis. Cons. Dept., Tomahawk, Wis. (Reinstatement).

Member Grade

Fulton, M. D., Asst. Dist. Mgr., Mosinee Paper Co., Solon Springs, Wis. (Junior 1953).
Hiller, R. L., Sales Rep., American Cyanamid, Hartland, Wis. Univ. Minn., BSF, 1938, (Junior 1956).
Landino, J. W., Pulpwood Procurement, Sterling Pulp & Paper Co., Eau Claire, Wis. (36R55).
Lehmann, W. A., Dist. Forester, Mich. Dept. of Cons., Sault Ste. Marie, Mich. Univ. Mich., BSF, 1943 (Junior 1956).
Leo, G. N., Tree Clearing Field Supv., Consumers Power Co., Jackson, Mich. Univ. Mich., BSF, 1954 (54R56).

Affiliate Grade

Garrett, R. E., Lake States Production Supt., Kimberly Clark Corp., Kingsford, Mich.
Hornick, J. R., Forester, Ottawa Natl. Forest, Ironwood, Mich. (Reinstatement).
Int-Hout, H. C., Forester, U. S. Steel Corp., Norway, Mich.
Serena, F. C., Forestry Aid General, USFS, Ironwood, Mich.
Smolich, W. N., Forester, U. S. Steel Corp., Ishpeming, Mich.
Uhazie, J. E., Foresters Aide, Kimberly Clark of Mich., Inc., Iron Mountain, Mich.
Waara, W. A., Supt., Copper Range Co., Houghton, Mich.
Wills, R. A., Forester, U. S. Steel Corp., Norway, Mich.

No Section

Corresponding Grade

Carpenter, A. P., Chief of Reforestation, Patrimonio Forestal del. Estado, Madrid, Spain.

Member Grade

Peterson, L. E., Chief, U. S. A. Operations Mission to Colombia, Bogota, Colombia. (Reinstatement).

Forestry News

JAMES R. LIENTZ, vice president of Union Bag-Camp Paper Corporation, recently "dibbled in" the 100,000,000th tree planted on lands owned by the Company in connection with their Savannah, Georgia, Mill. Lientz is shown doing the honors as W. J. Bridges, Jr., Union Bag-Camp woodlands director, holds the seedlings, and B. E. Allen, woodlands manager of the Savannah plant, looks on at the left.

The prized seedling was grown in the Company's Bellville Nursery, one of 21,750,000 produced there this year. Union Bag-Camp foresters estimate the company-owned land is currently being restocked at a rate of four trees planted for every one cut.

Planting in 1959 Tops Records

An alltime high of over 2 billion trees were planted in 1959 according to the Department of Agriculture. This record, according to the Department, is due largely to the increase in planting on private lands. A Forest Service summary shows 2,118,471 acres were planted, about one-third of which was land placed in the Conservation Reserve program under 10-year contracts. Private land plantings rose to 1.88 million trees in 1959 compared with 1.33 million in 1958. For the same years, planting on federal land rose to 167,610 acres from 133,509. Planting on other public lands decreased slightly, according to the report.

Forest Products Laboratory to Celebrate 50th Anniversary

The Golden Anniversary of the U. S. Forest Products Laboratory, oldest research organization of its kind in the world, will be observed June 2-4 at Madison, Wis.

Plans for the celebration, expected to bring hundreds of friends, "alumni," and well-wishers to Madison, were announced by Director Edward G. Locke. The 3-day affair, he said, will be touched off with a banquet Thursday evening, June 2. At a general meeting of Laboratory staff and guests Friday morning, key leaders in industry, government, and education will speak on various facets of research, past and future. And on Friday afternoon guests will tour the Laboratory to view special exhibits and witness dedicatory ceremonies.

All day Saturday, the Laboratory staff will hold open house for the public.

The pioneer Laboratory was dedicated June 4, 1910, to a career of public service which, Dr. Locke pointed out, has yielded rich returns to both producers and consumers of a multitude of wood products.

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National Forest Visits Continue to Increase

The Department of Agriculture reports that recreation visits to the national forests hit an all-time high in 1959, with the greatest use occurring on undeveloped areas where 1959 visits were up 33 percent from 1958.

National Park Service Reports Record 62,812,000 Visitors in 1959

Travel to the 29 National Parks and 154 other areas administered by the National Park Service totaled 62,812,000 in 1959, the National Park Service has reported to Secretary of the Interior Fred A. Seaton.

The 1959 total, an all-time record, showed an increase of 4,315,000 visitors over the 58,677,000 recorded in 1958, National Park Service Director Conrad L. Wirth said. The previous record was 59,285,000 in 1957.

Lumber Consumption in 1959 Reported

National consumption of lumber during 1959 totaled 40,470,000,000 feet, according to industry estimates released by the National Lumber Manufacturers Association. This was a gain of seven percent over 1957 and 1958 but a drop of two percent from 1956.

Softwood lumber consumption was 33,263,000,000 board feet, or eight percent above 1958, while consumption of hardwoods totaled 7,207,000,000 board feet, an increase of five percent. Per capita consumption of lumber in the U. S. amounted to 224 board feet in 1959, compared with 213 board feet in 1958, 215 board feet in 1957 and 241 board feet in 1956.

At the same time, the National Oak Flooring Manufacturers' Association reported that hardwood flooring demand in 1959 was the greatest in three years.

Forester Among Oregon Outstanding Young Men Candidates

Keith Petrie, Portland, Ore., recently represented Oregon's professional foresters as a candidate for Outstanding Young Man of Oregon. Although not one of the final three young men selected, he was one of 40 candidates submitted by organizations throughout the state.

The selection was sponsored by the state Junior Chamber of Commerce. Former Oregon Governor Charles A. Sprague, now publisher of the *Oregon Statesman*, Salem daily newspaper, headed the judges.

Widow of SAF Charter Member Dies

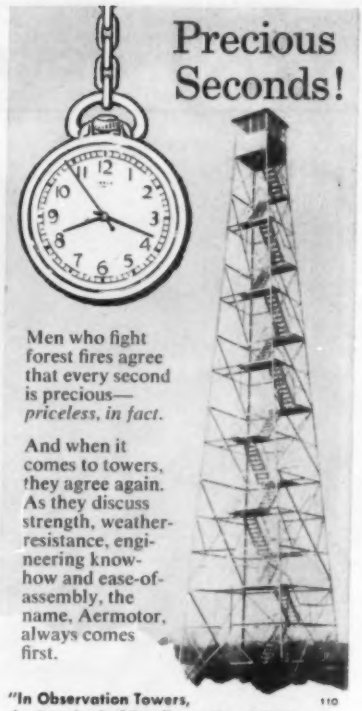
Drew Bennett Sherrard, widow of Thomas H. Sherrard, one of the Founders and Charter Members of the Society of American Foresters, died in Portland, Ore., on March 22. Mrs. Sherrard was a nationally known garden writer and a long-time contributor to the Home and Garden section of the (Portland) *Oregonian*. Her articles on gardening have appeared in *Woman's Home Companion, American Home, Better Homes and Gardens, Sunset,* and *Country Gentleman.*

Industrial & Private

W. E. Griffee Named Staff Chief of Western Pine

W. E. Griffee, Portland, Ore., was formally named secretary-manager of the Western Pine Association at the group's annual board of directors' meeting in San Francisco, March 5.

He succeeds S. V. Fullaway, Jr., who retired January 1 after heading the group for 30 years.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Griffee had been assistant secretary-manager of the association since 1936.

James D. Bronson, Yakima, was re-elected president of the association. Vice presidents are Kenneth R. Walker, Anderson, Calif., and J. B. Edens, Phoenix, Ariz. R. A. Rehfeld, Phoenix, was renamed treasurer.

TAPPI Forest Biology Symposium To Be Held in August

For the first time, a special Symposium on Forest Biology, sponsored by the Technical Association of the Pulp and Paper Industry (TAPPI) Forest Biology Committee, will be held August 24-26, 1960, at the New Washington Hotel, Seattle, Wash.

This three-day meeting is designed to attract both woodlands men and mill people interested in wood quality. Special sessions will be devoted to discussion of problems shared by both mill men and foresters. This conference also will be of interest to wood chemists and biologists.

Expected attendance at this meeting will be limited by the available facilities to approximately 200; therefore it is required that registrations for this symposium be made in advance of the opening date. Pre-registration forms will be available from

TAPPI, 360 Lexington Avenue, New York 17, N. Y.

R. J. Seidl, Simpson Timber Co., Seattle Wash., is general chairman of the symposium, and the technical program is being prepared by J. W. Duffield, W. B. Greeley Forest Nursery, Nisqually, Wash. Local arrangements will be handled by R. Z. Callaham, U. S. Forest Service, Inland Empire Research Center, Spokane, Wash. A. J. Winchester, TAPPI, New York, will act as treasurer and publicity director for the conference.

Westvaco Plants 7.5 Million Seedlings

Southern Woodlands Division of West Virginia Pulp and Paper approached the end of the 1960 planting season with a total of approximately 7½ million seedlings planted in woods and open fields, adding 10,700 acres of plantations to Westvaco's woodlands in South Carolina and Georgia. Completion of the 1960 season brings company plantings since 1945 to a grand total of 73,963,000 seedlings, covering approximately 102,000 acres. Principal species planted were loblolly and slash pine along with some cypress.

All planting stock during the last three years has been supplied by Westvaco's tree nursery near Summerville. The nursery, with a potential capacity of some 20 million seedlings annually, is part of the over-all forestry program being handled by West Virginia foresters. The program includes selection of superior seed trees, pine cone collection, and extraction and treatment of seeds in advance of nursery planting.

William Ernst, Jr., is manager of West Virginia Pulp and Paper's Southern Woodlands Division.

St. Regis Awards Two Fellowships

St. Regis Paper Company announces that in recognition of the importance of scientific forestry methods and tree genetics it again offers two fellowships in forestry in addition to five undergraduate scholarships in forestry. The fellowships are valued at $1,000 each, and are given for one year.

Winners of the two St. Regis Fellowships in Forestry this year are John P. Butt of the New York State College of Forestry and Gerald R. Stairs of the Yale University School of Forestry.

Mr. Butt will study for the degree of Master of Forestry at the New York State College of Forestry.

Mr. Stairs expects to work at the

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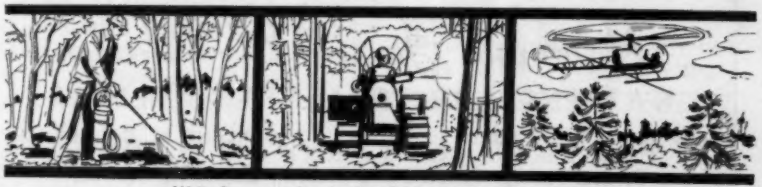

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Industry Research Post Filled

Donald B. Malmberg has been named to the newly created position of research forester for Crown Zellerbach Corporation's lower Columbia tree farms. He will be based at the Clatsop division near Seaside, Ore.

C. W. Richen, manager of the company's Northwest timber operations, in announcing the appointment said: "Mr. Malmberg's work will deal largely with western hemlock which is the predominant species on many of our coastal tree farms in Washington and Oregon."

The coastal project will be coordinated with similar studies now under way at the forest section of the company's Central Research Development laboratory in Camas, Wash.

A native of Oregon, Malmberg received his Bachelor of Science degree in forestry at Oregon State College. He earned his Master degree at the University of Washington. He has been employed as research forester for the Port Blakely Mill Co., Elma, Wash.

Veteran Industry Logger Dies

L. N. Rees, logging manager of Crown Zellerbach Corporation's Cathlamet, Wash., and Clackamas, Ore., logging division, died Thursday morning, March 24, in a Portland, Ore., hospital following a week-long confinement.

Mr. Rees was widely known throughout the forest industry as the inventor of the Rees air tongs and other logging equipment.

He was born in Idaho Falls, Idaho, on March 4, 1902. He joined Crown Zellerbach as a highclimber at its Wahkiakum county logging operation near Cathlamet, Wash., in 1927.

West Coast Industry Leader Retires

Retirement of C. H. Kreienbaum, vice chairman of Simpson Timber Company and a leader in West Coast forest products affairs through the past four decades, became effective March 2.

The Simpson executive was a leader in the West Coast Lumbermen's Association for many years and served as president in 1946. He also served as a director and officer of the National Lumber Manufacturers' Association;

Pacific Northwest Loggers Association; Puget Sound Scaling Bureau; and the California Redwood Association. He is an Affiliate member of the SAF.

Public

Utah State Parks Director Named

Wilford L. Hansen, assistant regional forester at Albuquerque, N. Mex., has been appointed the new director of Utah State Parks, it has been announced by Harold P. Fabian, chairman of the Utah State Parks Commission.

In his assignment Mr. Hansen will occupy the post vacated by the resignation of Director Chester J. Olsen which became effective April 1.

A native of Richfield, Utah, Hansen is a 1931 forestry graduate of Utah State University and holds a master degree in recreation from the New York State College of Forestry.

He served successively in various ranks from forest guard through forest supervisor in the Intermountain Region of the U. S. Forest Service from 1931 through 1948 on the Cache, Boise, and Uinta National Forests and was placed in charge of watershed management and recreation activities in the regional headquarters at Ogden, Utah, in 1948.

He was promoted to assistant regional forester in charge of watershed management, multiple use coordination and information in 1950.

E. L. Little on Assignment in Venezuela

Dr. Elbert L. Little, Jr., Forest Service dendrologist in the Washington Office, has accepted for the spring term the position of visiting professor of dendrology in the Forestry School, University of the Andes, Merida, Venezuela. While there, Dr. Little plans to complete a book on the trees of Venezuela, which he started on a previous assignment to the same position in 1953-1954. Dr. Little will return to his position in Washington in July.

Named to Rocky Mountain Station Staff

Dr. F. Dean Freeland has been appointed to the research staff of the Rocky Mountain Forest and Range Experiment Station, Fort Collins, Colo., Director Raymond Price has announced. In a newly created position, he will work on watershed management projects in the central Rocky Mountains.

F. DEAN FREELAND

Before joining the station, Dr. Freeland was assistant professor of forestry at Michigan State University. He had previously worked at U. S. Forest Service experiment stations in Columbus, Ohio, and Asheville, N. C., and as a technical adviser in tropical forestry in Colombia, South America.

He received his bachelor and master degrees in forestry from the University of Michigan and his Ph.D. in forest soils and influences from Michigan State University in 1956. During World Wor II, he served with the U. S. Marine Corps in China and the Pacific.

Forest Supervisor Selected For Washington Post, Successor Named

Veldon A. Parker, supervisor of the Lassen National Forest, Calif., was promoted and transferred in April to the position of chief of the Branch of Directives Management in the Division of Administrative Management,

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Washington, D. C., according to Regional Forester Chas. A. Connaughton, San Francisco.

Parker graduated with a degree in forestry from Oregon State College in 1932. His career with the U. S. Forest Service started in 1929 with summer work. In 1933 he was transferred to California where he served in various assignments on the Modoc, Plumas, Shasta and Lassen National Forests. In 1949 he became Training and Safety Officer in the San Francisco Regional Headquarters. Mr. Parker returned to the Lassen National Forest as supervisor in 1951.

Irwin J. Bosworth, forester in charge of timber management, Plumas National Forest, has been promoted to supervisor of the Lassen National Forest.

Bosworth started his Forest Service career as fire guard on the Angeles National Forest in 1939. He has moved progressively through the ranks of the Forest Service as fire control assistant, fire dispatcher, timber management assistant, district ranger and forester on the Angeles, Shasta, and Plumas National Forests, being assigned to his present position on the Plumas National Forest in 1955. He is a graduate of the University of California School of Forestry at Berkeley. He participated in an intensive Administrative Management Training course given by the USDA Leadership Conference in 1959.

Schools

Kraemer Named Visiting Professor at Syracuse

Dr. Hardy L. Shirley, dean of the State University College of Forestry at Syracuse University, has announced that Dr. J. Hugo Kraemer has recently been appointed to the college as visiting associate professor of world forestry in the Department of Forestry Economics.

Dr. Kraemer is in charge of the world forestry program for undergraduate and graduate students, providing instruction in world forestry problems, as well as possibility statistics.

Kraemer graduated from The New York State Ranger School in 1928. He received a B.S. degree from the University of Idaho in 1934. One year later, he earned a Master of Forestry degree from Harvard University, and in 1943, a Ph.D. was conferred upon him by Yale University.

Dr. Kraemer was a consulting forester from 1955 to 1959. During 1953-

J. HUGO KRAEMER

1954 he served in Korea as chief of the Division of Forestry, U.N. Korean Reconstruction Agency. He was a member of the faculty of Purdue University from 1947 to 1951 and, during World War II, was chief of the Forest Resources Unit of the Board of Economic Welfare.

Dr. Kraemer has traveled extensively and is the author of numerous publications on forestry, wood technology, and foreign resource development.

Harlow Wins International Film Award

A faculty member of the State University College of Forestry at Syracuse University, Syracuse, N. Y., is one of two Americans receiving top awards for scientific-didactic films entered in the recent Venice International Film Festival.

The film festival's Committee on International Non-Theatrical Events recently announced that Dr. William M. Harlow, professor of wood technology

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at the College of Forestry, has been awarded the Bucranio d'Argento for his educational film production entitled "Rhythmic Motions of Growing Plants."

For his outstanding achievement, the University of Padua, Padua, Italy, has awarded Dr. Harlow a silver medallion and a special citation for his entry. Both awards have been transmitted to Dr. Harlow through the Italian Embassy in Washington, D. C.

"Rhythmic Motions of Growing Plants" was selected for top honors for its "outstanding excellence as a teaching film in science."

The Bucranio d'Argento is the highest award given biennially by the Venice International Film Festival for the best scientific-didactic films produced.

Dr. Harlow's "Rhythmic Motions of Growing Plants" also has won the American Film Festival's highest award in the science category.

University of Missouri Announces Staff Appointments

Two major positions on the staff of the School of Forestry, University of Missouri, have been filled by Dr. Gene S. Cox and Dr. E. Allan McGinnes, Jr.

Dr. Cox fills one of the vacancies created by the recent resignations of Dr. Peter W. Fletcher and Dr. R. E. McDermott. He will handle some of the basic courses in the field of silviculture and will devote about half time to research in tree physiology and soils. Dr. Cox has three degrees from Duke University. He has been on the staff of the School of Forestry at Montana State University, Missoula, Mont., since 1953 where he was an associate professor since 1957. Previously he served as an assistant professor on the staff of the Department of Forestry of Stephen F. Austin State College at Nacogdoches, Texas, from 1951 to 1953.

Dr. McGinnes fills a new position in research in wood technology and products. He will work closely with woodusing industries in an attempt to assist them in producing better quality wood products, as well as new products. Dr. McGinnes has degrees from Pennsylvania State University, and a Ph.D. from New York State College of Forestry at Syracuse. Since 1951 he has been employed by the American Viscose Corporation and has been working in their Research and Development Division at Marcus Hook, Pa.

Carl Settergren, a graduate of the class of 1958 who completed work for a master degree in Februray, was appointed to the staff as an instructor in forestry.

G. S. Cox

E. A. McGinnes

Lassen Junior College Revises Forestry Program

Lassen Junior College in Susanville, Calif., will alter its 25-year-old program in forestry beginning with the fall semester of 1960. The major change is the switch-over from the unit type course, which is a concentrated study of one subject for a given number of weeks at three hours per day, to the usual semester length course. This change, coupled with greater allowance for full days of field work where required, will give Lassen a program more closely aligned with other curricula of the ranger school type.

A feature of the Lassen ranger school program is the close coupling it achieves with the other academic subjects taught at the college. The new plan has two options. The first option places the students with a satisfactory high school record in forestry classes 6 hours per day, five days per week, for one year. During the second year the forestry students take their general academic requirements for the Associate of Arts degree. At the completion of the second year the graduating forester receives a Forestry Certificate and the Associcate of Arts degree.

The second option is designed for those students having a high school record weak in mathematics, English, and science. These students will be placed in the academic program for one year to meet their requirements for the Associate of Arts degree and better prepare themselves for the more technical phases of the forestry program the following year.

Harry Mosher, head of the Forestry Department, believes that this revised program will turn out men trained to do many of the routine technical jobs now done by four-year graduates. In expectation of increased enrollment in the new program an additional teacher will be added to the forestry staff.

Advanced Forest Management Course Given By Michigan State

A graduate course in advanced forest management has been given by Michigan State University this winter at Iron Mountain, Mich. Twenty-six graduate foresters from the surrounding area met for a 3-hour class once a week at the Iron Mountain high school during the regular 10-week winter quarter from January 9 to March 19. The enrollment included technical foresters from several forest indus-

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tries, the Michigan Department of Conservation, the U. S. Forest Service, and private forest employment.

Dr. V. J. Rudolph, forest management specialist on the Department of Forestry staff at Michigan State University, and Mr. Carl Arbogast, Jr., leader of the Upper Peninsula Research Center, U. S. Forest Service, Marquette, Mich, taught the course jointly.

Advanced forest management techniques for private, industrial, and public forests were stressed in the course, as well as recent developments in forest management. The course was offered under the auspices of Michigan State University's Continuing Education Service. Rudolph and Arbogast have taught the course in Michigan's Upper Peninsula before—in Marquette in 1958, and in Newberry in 1959.

First Logging Safety Institute at the University of Washington

A Logging Safety Institute cosponsored by the Pacific Northwest Loggers Association and the University of Washington College of Forestry was held on the university campus on February 4 and 5.

Designed at the small businessman's level, 87 registrants learned how they could improve safety performance in their operations and reduce accident costs. Among them were 22 operators employing less than 10 men, and 18 others came from operations employing less than 50 men. While most of the registrants came from Oregon and Washington several came from Alaska.

Professors J. Kenneth Pearce and George Stenzel of the College of Forestry, University of Washington, acted as general chairmen of the four half-day sessions.

The program included sessions on "Need for Accident Prevention in the Logging Industry," "Accidents—Causes and Cures," "The How of Accident Prevention Organization," and "Development of an Effective Safety Program."

Plans are being formulated to hold another Logging Safety Institute early next year.

Industry Executive Lectures At California

Herbert C. Sampert, lumber industry executive, was appointed lecturer and associate specialist in forestry at the University of California School of Forestry, Berkeley, for the spring semester.

He is teaching forest engineering and related subjects.

Sampert has occupied managerial positions in California and Oregon forest industry concerns for the past 20 years. His assignments have included five years with the Collins interests at Quincy, Calif., and 13 years as production manager of Elk Lumber Company of Medford, Ore. In his most recent past, he served as general manager of Dwyer Lumber and Plywood Company of Portland, Ore.

He received his Bachelor of Forestry degree at Oregon State College and a Master of Forestry degree from the New York State College of Forestry.

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Forestry Employment

Humboldt State College has announced a vacancy for an assistant professor of forestry to be filled by September 1. Salary range is $6,060-$7,008 for academic year (9 months). Teaching specialities: forest engineering; forest mensuration, scaling and cruising; and forest mensuration, statistics and growth. Age under 45 preferred. Candidate who will have completed work for doctorate by September 1 is preferred. Address application with photograph to Dr. Homer P. Balabanis, dean of instruction, Humboldt State College, Arcata, California.

Positions Wanted

Forester, B.S., 1955, Pennsylvania State Univ. Age 28, single. Experience: 2 summers U. S. Forest Service in Oregon, 15 months state forest inventory in Northwest, 21 months in Navy SeaBee's procuring lumber and building materials, and presently employed with U.S. Forest Service, one year in Oregon doing timber sale work. Desire private industry position in wood utilization, or intensive timber management in Middle Atlantic States or California.
Box R, Journal of Forestry, Mills Building, Washington 6, D. C.

Forester, B.S., 1957 M.C.M.T. Age 27, married, 3 children. Experience: 3 years with large paper company in Southeast; forest management, cruising, scaling, marking, surveying, fire protection, planting, administration, and supervision of personnel in forestry work. Desire position in Forestry or related field in Lake States area.
Box S, Journal of Forestry, Mills Building, Washington 6, D. C.

Forester, B.S., 1958, New York State College of Forestry. Age 24, married. Experience: one summer with Forest Service in California, one summer at forest experiment station, part time work in forest tree improvement. Work included timber management, forest nursery work, growth studies, grafting, controlled pollination. Desire employment with private industry, any location. Available in July, following discharge from Army.
Box T, Journal of Forestry, Mills Building, Washington 6, D. C.

Veteran logger chooses a D6 for salvage logging

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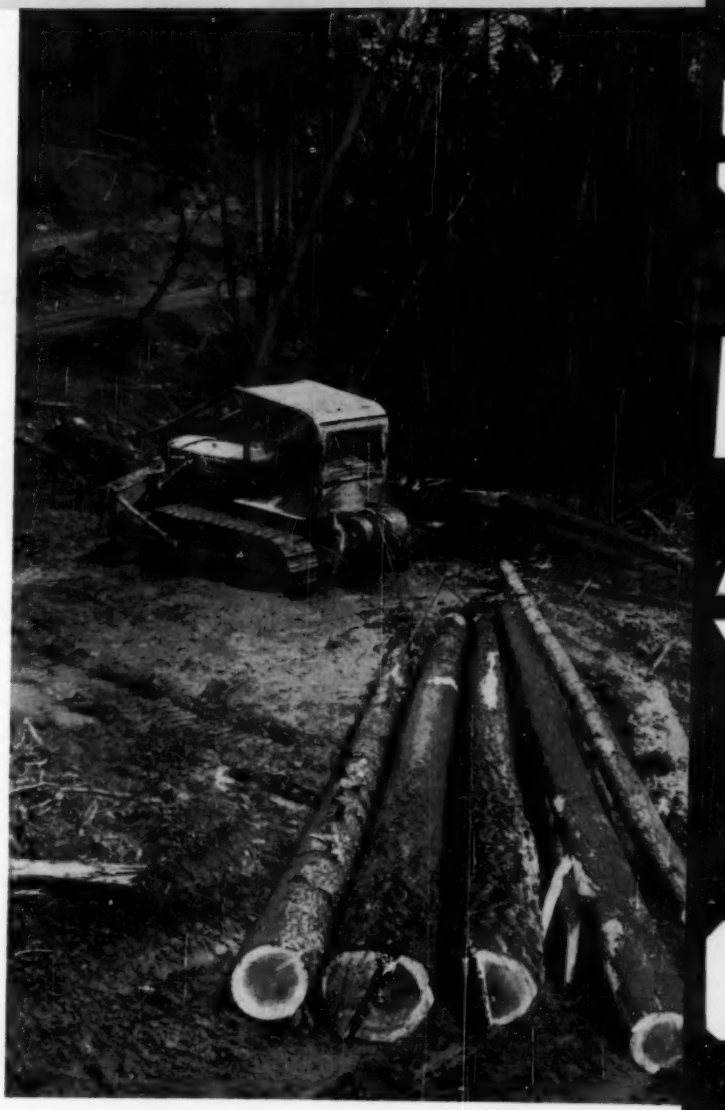

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